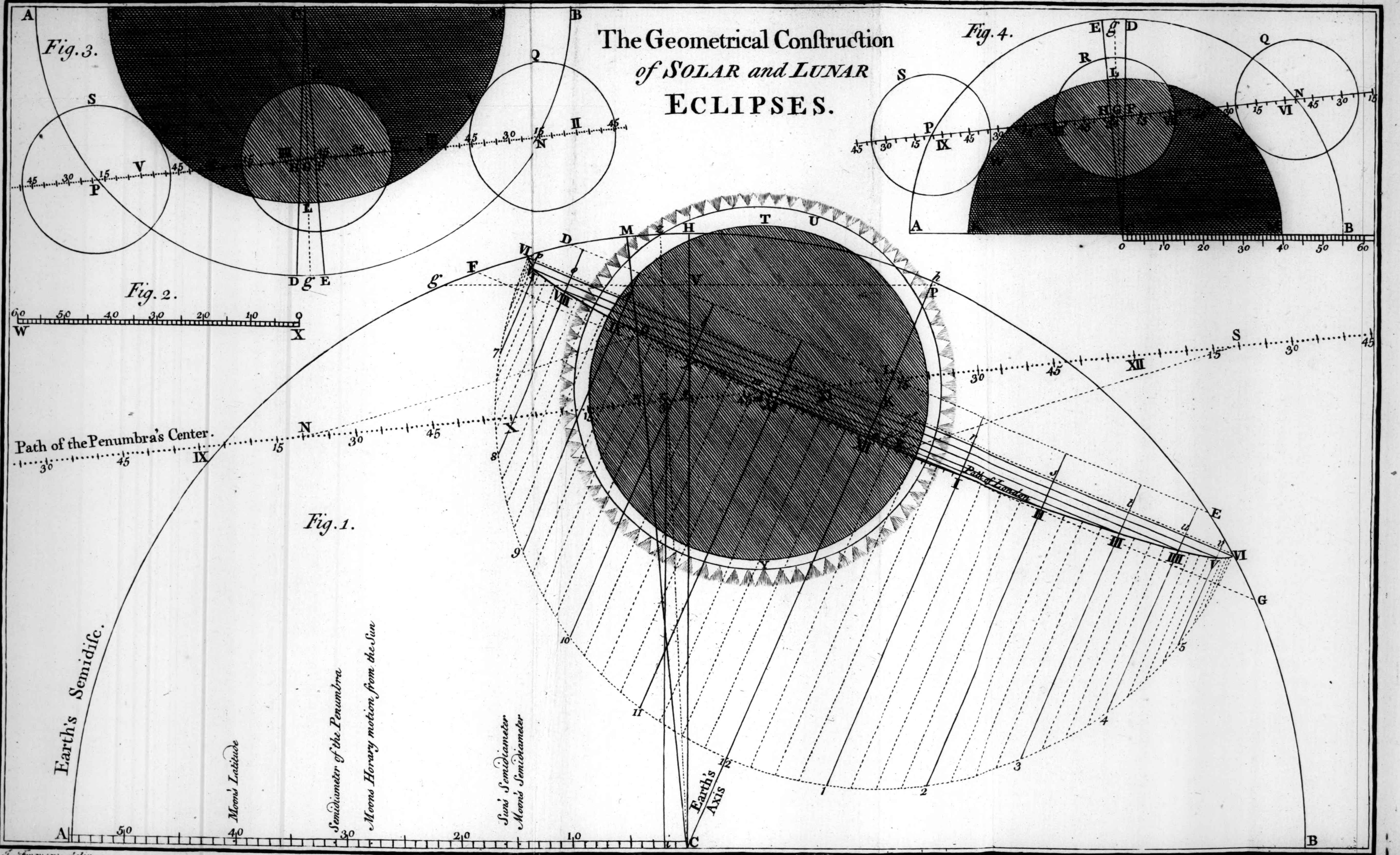
The Geometrical Construction of *SOLAR and LUNAR* ECLIPSES.



J. Ferguson delin.

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Aſtronomical Tables

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AND

PRECEPTS,

For calculating the true Times of

NEW and FULL MOONS,

And ſhewing the method of projecting

ECLIPSES,

FROM THE

CREATION of the WORLD to A. D. 7800.

To which is prefixed,

A Short THEORY

OF THE

SOLAR and LUNAR Motions.

By JAMES FERGUSON.

LONDON,
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BRITISH MUSEUM

THE

THEORY

OF THE

SOLAR and LUNAR Motions,

OR

PRINCIPLES

ON WHICH

The following TABLES are conſtructed.

1. THE nearer any object is to the eye of an obſerver, the greater is the angle under which it appears: the farther from the eye, the leſs.

2. The diameters of the ſun and moon ſubtend different angles at different times. And, at equal intervals of time, theſe angles are once at the greateſt, and once at the leaſt, in ſomewhat more than a compleat revolution of the luminary through the ecliptic, from any given fixed ſtar to the ſame ſtar again.—This proves that the ſun and moon are conſtantly changing their diſtances from the earth; and that they are once at their greateſt diſtance, and once at their leaſt, in little more than a compleat revolution.

3. The gradual differences of theſe angles are not what they would be, if the luminaries moved in circular orbits, the earth being ſuppoſed to be placed at ſome diſtance from the center: but they agree perfectly with elliptic orbits, ſuppoſing the lower focus of each orbit to be at the center of the earth.

4. The fartheſt point of each orbit from the earth's center is called the *apogee*, and the neareſt point is called the *perigee*.—Theſe points are directly oppoſite to each other.

5. Aſtronomers divide each orbit into 12 equal parts, called *ſigns*; each ſign into 30 equal parts, called *degrees*; each degree into 60 equal parts, called *minutes*; and every minute into 60 equal parts, called *ſeconds*. The diſtance of the ſun or moon from any given point of its orbit, is reckoned in ſigns, degrees, minutes, and ſeconds. Here we mean the diſtance that the luminary has moved through from any given point; not the ſpace it is ſhort thereof in coming round again, though ever ſo little.

6. The diſtance of the ſun or moon from its apogee, at any given time, is called its *mean anomaly*: ſo that, in the apogee, the anomaly is nothing; in the perigee, it is ſix ſigns.

7. The motions of the ſun and moon are obſerved to be continually accelerated from the apogee to the perigee, and as gradually retarded from the perigee to the apogee; being ſloweſt of all when the mean anomaly is nothing, and ſwifteſt of all when it is ſix ſigns.

8. When the luminary is in its apogee or perigee, its place is the ſame as it would be, if its motion were equable in all parts of its orbit.—The ſuppoſed equable motions are called *mean*; the unequable are juſtly called the *true*.

9. The mean place of the ſun or moon, is always forwarder than the true place*, whilſt the luminary

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* The point of the ecliptic in which the ſun or moon is, at any given moment of time, is called the *place* of the ſun or moon at that time.

is moving from its apogee to its perigee; and the true place is always forwarder than the mean, whilſt the luminary is moving from its perigee to its apogee.—In the former caſe, the anomaly is always leſs than ſix ſigns; and in the latter caſe more.

10. It has been found, by a long ſeries of obſervations, that the ſun goes through the ecliptic, from the *vernal equinox* to the ſame equinox again, in 365 days 5 hours 48 minutes 55 ſeconds: from the *firſt ſtar* of *Aries* to the ſame ſtar again, in 365 days 6 hours 9 minutes 24 ſeconds: and from his *apogee* to the ſame again, in 365 days 6 hours 14 minutes 0 ſeconds.—The firſt of theſe is called the *ſolar year*, the ſecond the *ſydereal year*, and the third the *anomaliſtic year*. So that the ſolar year is 20 minutes 29 ſeconds ſhorter than the ſydereal; and the ſydereal year is 4 minutes 36 ſeconds ſhorter than the anomalaſtic.—Hence it appears, that the *equinoctial point*, or interſection of the ecliptic and equator at the beginning of Aries, goes backward with reſpect to the fixed ſtars; and that the ſun's apogee goes forward.

11. It is alſo obſerved, that the moon goes through her orbit, from any given fixed ſtar to the ſame ſtar again, in 27 days 7 hours 43 minutes 4 ſeconds, at a mean rate: from her apogee to her apogee again, in 27 days 13 hours 18 minutes 43 ſeconds: and from the ſun to the ſun again, in 29 days 12 hours 44 minutes $3\frac{1}{20}$ ſeconds.—This ſhews, that the moon's apogee moves forward in the ecliptic, and *that* at a much quicker rate than the ſun's apogee does; ſince the moon is 5 hours 55 minutes 39 ſeconds longer in revolving from her apogee to her apogee again, than from any ſtar to the ſame ſtar again.

The moon's orbit croſſes the ecliptic in two oppoſite points, which are called her *nodes:* and it is obſerved that ſhe revolves ſooner from any node to the ſame node again, than from any ſtar to the ſame ſtar again, by 2 hours 38 minutes 27 ſeconds; which ſhews that her nodes move backward, or contrary to the order of ſigns, in the ecliptic.

12. The time in which the moon revolves from the ſun to the ſun again (or from change to change) is called a *lunation*; (which, according to Dr. POUND's mean meaſures, would always conſiſt of 29 days 12 hours 44 minutes 3 ſeconds 2 thirds 58 fourths, if the motions of the ſun and moon were always equable.—Hence, 12 mean lunations contain 354 days 8 hours 48 minutes 36 ſeconds 35 thirds 40 fourths, which is 10 days 21 hours 11 minutes 23 ſeconds 24 thirds 20 fourths leſs than the length of a common *Julian year*, conſiſting of 365 days 6 hours: and 13 mean lunations contain 383 days 21 hours 32 minutes 39 ſeconds 38 thirds 38 fourths, which exceeds the length of a common Julian year, by 18 days 15 hours 32 minutes 39 ſeconds 38 thirds 38 fourths.

13. Having found the mean time of new moon for any given year and month, as ſuppoſe for March 1700, old ſtyle; if this mean new moon falls later than the 11th day of March, then, 12 mean lunations added to the time of this mean new moon, will give the time of the mean new moon in March 1701, after having thrown off 365 days.—But, when the mean new moon happens to be before the 11th of March, we muſt add 13 mean lunations, in order to have the time of mean new moon in March the year following: always taking care to ſubtract 365

days in common years, and 366 days in leap-years, from the ſum of this addition.

Thus, A. D. 1700, old ſtyle, the time of mean new moon in March was the 8th day, at 16 hours 11 minutes 25 ſeconds after the noon of that day (*viz.* at 11 minutes 25 ſeconds paſt IV in the morning of the 9th day, according to common reckoning.) To this we muſt add 13 mean lunations, or 383 days 21 hours 32 minutes 39 ſeconds 38 thirds 38 fourths, and the ſum will be 392 days 13 hours 44 minutes 4 ſeconds 38 thirds 38 fourths; from which ſubtract 365 days, becauſe the year 1701 is a common year, and there will remain 27 days 13 hours 44 minutes 4 ſeconds 38 thirds 38 fourths for the time of mean new moon in March, A. D. 1701.

Carrying on this addition and ſubtraction till A. D. 1703, we find the time of mean new moon in March that year, to be on the 6th day, at 7 hours 21 minutes 17 ſeconds 49 thirds 46 fourths paſt noon; to which add 13 mean lunations, and the ſum will be 390 days 4 hours 53 minutes 57 ſeconds 28 thirds 20 fourths; from which ſubtract 366 days, becauſe the year 1704 is a leap-year, and there will remain 24 days 4 hours 53 minutes 57 ſeconds 28 thirds 20 fourths for the time of mean new moon in March, A. D. 1704.

In this manner was the firſt of the following tables conſtructed to ſeconds, thirds and fourths; and then wrote out to the neareſt ſeconds.—The reaſon why we choſe to begin the year with March, was to avoid the inconvenience of adding a day to the tabular time in leap-years after February, or ſubtracting a day therefrom in January and February in thoſe years; to which all tables of this kind are ſubject, which begin the year with January, in calculating the times of new or full moons.

The mean anomalies of the ſun and moon, and the ſun's mean motion from the aſcending node of the moon's orbit, are ſet down in Table III. from one to 13 mean lunations.—Theſe numbers, for 13 lunations, being added to the radical anomalies of the ſun and moon, and to the ſun's mean diſtance from the aſcending node, at the time of mean new moon in March 1700, (Table I.) will give their mean anomalies, and the ſun's mean diſtance from the node, at the time of mean new moon in March 1701; and being added for 12 lunations to thoſe for 1701, give them for the time of mean new moon in March 1702. And ſo on, as far as you pleaſe to continue the table (which is here carried on to the year 1800) always throwing off 12 ſigns when their ſum exceeds 12, and ſetting down the remainder as the proper quantity.

14. If the numbers belonging to A. D. 1700 (in Table I.) be ſubtracted from thoſe belonging to 1800, we ſhall have their whole differences in 100 compleat Julian years; which accordingly we find to be 4 days 8 hours 10 minutes 52 ſeconds 15 thirds 40 fourths, with reſpect to the time of mean new moon.—Theſe being added together 60 times (always taking care to throw off a whole lunation when the days exceed 29½) make up 60 centuries, or 6000 years, as in Table VI, which was carried on to ſeconds, thirds, and fourths; and then wrote out to the neareſt ſeconds. In the ſame manner were the reſpective anomalies and the ſun's diſtance from the node found, for theſe centuries; and then (for want

of

of room) wrote out only to the neareſt minutes; which is ſufficient in whole centuries.—By means of theſe two Tables, we may find the time of any mean new moon in March, together with the anomalies of the ſun and moon, and the ſun's diſtance from the node, at theſe times, within the limits of 6000 years, either before or after any given year in the 18th century; and the mean time of any new or full moon in any given month after March, by means of the third and fourth Tables, within the ſame limits, as ſhewn in the precepts for calculation.

15. Thus it would be a very eaſy matter to calculate the time of any new or full moon, if the ſun and moon moved equably in all parts of their orbits. —But we have already ſhewn (§ 7, 8) that their places are never the ſame as they would be by equable motions, except when they are in apogee or perigee; which is, when their mean anomalies are either nothing, or ſix ſigns: and that their mean places are always forwarder than their true places, whilſt the anomaly is leſs than ſix ſigns; and their true places are forwarder than the mean, whilſt the anomaly is more.

16. Hence it is evident, that whilſt the ſun's anomaly is leſs than ſix ſigns, the moon will overtake him, or be oppoſite to him, ſooner than ſhe could if his motion was equable; and later whilſt his anomaly is more than ſix ſigns.—The greateſt difference that can poſſibly happen between the mean and true time of new or full moon, on account of the inequality of the ſun's motion, is 3 hours 48 minutes 28 ſeconds: and that is, when the ſun's anomaly is either 3 ſigns 1 degree, or 8 ſigns 29 degrees; ſooner in the firſt caſe, and later in the laſt.—

In all other ſigns and degrees of anomaly, the difference is gradually leſs, and vaniſhes when the anomaly is either nothing or ſix ſigns.

17. The ſun is in his apogee on the 30th of June, and in his perigee on the 30th of December, in the preſent age: ſo that he is nearer the earth in our ſummer than in our winter.—The proportional difference of diſtance, deduced from the difference of the ſun's apparent diameter at theſe times, is as 983 to 1017.

18. The moon's orbit is dilated in winter, and contracted in ſummer; therefore, the lunations are longer in winter than in ſummer. The greateſt difference is found to be 22 minutes 29 ſeconds: the lunations increaſing gradually in length whilſt the ſun is moving from his apogee to his perigee, and decreaſing in length whilſt he is moving from his perigee to his apogee.—On this account, the moon will be later every time in coming to her conjunction with the ſun, or being in oppoſition to him, from December till June, and ſooner from June till December, than if her orbit had continued of the ſame ſize all the year round.

19. As both theſe differences (§ 16, 18) depend on the ſun's anomaly, they may be fitly put together into one Table, and called *The annual, or firſt equation of the mean to the true* * *ſyzygy* (ſee Table VIII.) This equational difference is to be ſubtracted from the time of the mean ſyzygy when the ſun's anomaly is leſs than ſix ſigns, and added when the anomaly is more.—At the greateſt, it is 4 hours 10 minutes 57 ſeconds; *viz.* 3 hours 48 mi-

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* The word *ſyzygy* ſignifies both the conjunction and oppoſition of the ſun and moon.

nutes 28 ſeconds, on account of the ſun's unequal motion, and 22 minutes 29 ſeconds, on account of the dilatation of the moon's orbit.

20. This compound equation would be ſufficient for reducing the mean time of new or full moon to the true time thereof, if the moon's orbit were of a circular form, and her motion quite equable in it.—But the moon's orbit is more elliptical than the ſun's, and her motion in it ſo much the more unequal. The difference is ſo great, that ſhe is ſometimes in conjunction with the ſun, or in oppoſition to him, ſooner by 9 hours 47 minutes 54 ſeconds, than ſhe would be if her motion were equable; and at other times as much later.—The former happens when her mean anomaly is 9 ſigns 4 degrees, and the latter when it is 2 ſigns 26 degrees. *See Table* IX.

21. At different diſtances of the ſun from the moon's apogee, the figure of the moon's orbit becomes different.—It is longeſt of all, or moſt excentric, when the ſun is in the ſame ſign and degree either with the moon's apogee or perigee; ſhorteſt of all, or leaſt excentric, when the ſun's diſtance from the moon's apogee is either three ſigns or nine ſigns; and at a mean ſtate when the diſtance is either 1 ſign 15 degrees, 4 ſigns 15 degrees, 7 ſigns 15 degrees, or 10 ſigns 15 degrees.—When the moon's orbit is at its greateſt excentricity, her apogeal diſtance from the earth's center is to her perigeal diſtance therefrom, as 1067 is to 933; when leaſt excentric, as 1043 is to 957; and when at the mean ſtate, as 1055 is to 945.

22. But the ſun's diſtance from the moon's apogee is equal to the quantity of the moon's mean anomaly at the time of new moon, and by the ad-

dition of ſix ſigns, it becomes equal in quantity to the moon's mean anomaly at the time of full moon.—Therefore, a Table may be conſtructed ſo as to anſwer to all the various inequalities depending on the different excentricities of the moon's orbit, in the ſyzygies; and called *The ſecond equation of the mean to the true ſyzygy* (ſee Table IX.) and the moon's anomaly, when equated by Table VIII, may be made the proper argument for taking out this ſecond equation of time; which muſt be added to the former equated time, when the moon's anomaly is leſs than ſix ſigns, and ſubtracted when the anomaly is more.

23. There are ſeveral other inequalities in the moon's motion, which ſometimes bring on the true ſyzygy a little ſooner, and at other times keep it back a little later, than it would otherwiſe be: but they are ſo ſmall, that they may be all omitted except two; the former of which (*ſee Table* X.) depends on the difference between the anomalies of the ſun and moon in the ſyzygies, and the latter (*ſee Table* XI.) depends on the ſun's diſtance from the moon's nodes at theſe times.—The greateſt difference ariſing from the former, is 4 minutes 58 ſeconds; and from the latter, 1 minute 34 ſeconds.

Having deſcribed the phænomena ariſing from the inequalities of the ſolar and lunar motions, we ſhall now ſhew the reaſons of theſe inequalities.

In all calculations relating to the ſun and moon, we conſider the ſun as a moving body, and the earth as a body at reſt; ſince all the appearances are the ſame whether it be the ſun or the earth that moves.—But the truth is, that the ſun is at reſt, and the earth moves round him once a year, in the plane of the ecliptic. Therefore, whatever ſign and degree of the ecliptic the earth is in, at any given time, the ſun will then appear to be in the oppoſite.

The nearer that any body is to the ſun, the more it is attracted by him; and this attraction increaſes as the ſquare of the diſtance diminiſhes; and *vice verſâ*.

The earth's annual orbit is elliptical, and the ſun is placed in one of its focuſes. The remoteſt point of the earth's orbit from the ſun, is called *the earth's aphelion*; and the neareſt point of the earth's orbit to the ſun, is called *the earth's perihelion*.—When the earth is in its aphelion, the ſun appears to be in its apogee; and when the earth is in its perihelion, the ſun appears to be in its perigee.

As the earth moves from its aphelion to its perihelion, it is conſtantly more and more attracted by the ſun; and this attraction, by conſpiring in ſome degree with the earth's motion, muſt neceſſarily accelerate it. But as the earth moves from its perihelion to its aphelion, it is continually leſs and leſs attracted by the ſun; and as this attraction acts then juſt as much againſt the earth's motion, as it acted for it in the other half of the orbit, it retards the motion in the like degree.—The faſter the earth moves, the faſter will the ſun appear to move; the ſlower the earth moves, the ſlower is the ſun's apparent motion.

The moon's orbit is alſo elliptical, and the earth keeps conſtantly in one of its focal points.—The earth's attraction has the ſame kind of influence on the moon's motion, as the ſun's attraction has on the motion of the earth: and therefore, the moon's motion muſt be continually accelerated whilſt ſhe is paſſing from her apogee to her perigee; and as gradually retarded in moving from her perigee to her apogee.

At the time of new moon, the moon is nearer the ſun than the earth is at that time, by the whole ſemi-diameter of the moon's orbit; which, at a mean ſtate, is 240,000 miles: and at the full, ſhe is as much farther from the ſun than the earth then is.—Conſequently, the ſun attracts the moon more than it attracts the earth in the former caſe, and leſs in the latter. The difference is greateſt when the earth is neareſt the ſun, and leaſt when it is fartheſt from him. The obvious reſult of this is, that as the earth is neareſt to the ſun in winter, and fartheſt from him in ſummer, the moon's orbit muſt be dilated in winter, and contracted in ſummer.

Theſe are the principal cauſes of the difference of time, that generally happens between the mean and true times of conjunction or oppoſition of the ſun and moon. As to the other two differences, *viz.* thoſe which depend on the difference between the anomalies of the ſun and moon, and upon the ſun's diſtance from the lunar nodes, in the ſyzygies, they are owing to the different degrees of attraction of the ſun and earth upon the moon, at greater or leſs diſtances, according to their reſpective anomalies, and to the poſition of the moon's nodes with reſpect to the ſun.

If ever it ſhould happen, that the anomalies of both the ſun and moon were either nothing or ſix ſigns, at the mean time of new or full moon, and the ſun ſhould then be in conjunction with either of the moon's nodes, all the abovementioned equations would vaniſh, and the mean and true time of the ſyzygy would coincide.—But if ever this circumſtance did happen, we cannot expect the like again in many ages afterward.

TABLE I. *The mean time of new moon in March, old ſtyle; with the mean anomalies of the ſun and moon, and the ſun's mean diſtance from the moon's aſcending node, from A. D.* 1700, *to A. D.* 1800 *incluſive.*

Years of Chriſt.	New Moon in March.				Sun's Anomaly.				Moon's Anomaly.				Sun's diſt. fr. the Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1700	8	16	11	25	8	19	58	48	1	22	30	37	6	14	31	7
1701	27	13	44	5	9	8	20	59	0	28	7	42	7	23	14	8
1702	16	22	32	41	8	27	36	51	11	7	55	47	8	1	16	55
1703	6	7	21	18	8	16	52	43	9	17	43	52	8	9	19	42
1704	24	4	53	57	9	5	14	54	8	23	20	57	9	18	2	43
1705	13	13	42	34	8	24	30	47	7	3	9	2	9	26	5	30
1706	2	22	31	11	8	13	46	39	5	12	57	7	10	4	8	17
1707	21	20	3	50	9	2	8	50	4	18	34	13	11	12	51	18
1708	10	4	52	27	8	21	24	43	2	28	22	18	11	20	54	5
1709	29	2	25	7	9	9	46	54	2	3	59	24	0	29	37	6
1710	18	11	13	43	8	29	2	47	0	13	47	30	1	7	39	54
1711	7	20	2	20	8	18	18	39	10	23	35	36	1	15	42	41
1712	25	17	34	59	9	6	40	51	9	29	12	42	2	14	25	43
1713	15	2	23	36	8	25	56	43	8	9	0	47	3	2	28	30
1714	4	11	12	13	8	15	12	35	6	18	48	52	3	10	31	17
1715	23	8	44	52	9	3	34	47	5	24	25	57	4	19	14	18
1716	11	17	33	29	8	22	50	39	4	4	14	2	4	27	17	5
1717	1	2	22	5	8	12	6	32	2	14	2	8	5	5	19	52
1718	19	23	54	45	9	0	28	44	1	19	39	13	6	14	2	54
1719	9	8	43	22	8	19	44	37	11	29	27	18	6	22	5	41
1720	27	6	16	1	9	8	6	49	11	5	4	24	8	0	48	42
1721	16	15	4	38	8	27	22	41	9	14	52	29	8	8	51	29
1722	5	23	53	14	8	16	38	33	7	24	40	34	8	16	54	16
1723	24	21	25	54	9	5	0	45	7	0	17	40	9	25	37	18
1724	13	6	14	31	8	24	16	37	5	10	5	45	10	3	40	5
1725	2	15	3	7	8	13	32	29	3	19	53	50	10	11	42	52
1726	21	12	35	47	9	1	54	41	2	25	30	56	11	20	25	54
1727	10	21	24	23	8	21	10	34	1	5	19	1	11	28	28	41
1728	28	18	57	3	9	9	32	46	0	10	56	7	1	7	11	42
1729	18	3	45	40	8	28	48	39	10	20	44	12	1	15	14	29
1730	7	12	34	16	8	18	4	31	9	0	32	17	1	23	17	16
1731	26	10	6	56	9	6	26	42	8	6	9	23	3	2	0	17
1732	14	18	55	33	8	25	42	34	6	15	57	28	3	10	3	4

TABLE I. *continued* O. S.

Years of Christ.	New Moon in March.				Sun's Anomaly.				Moon's Anomaly.				Sun's dist. fr. the Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1733	4	3	44	9	8	14	58	26	4	25	45	33	3	18	5	51
1734	23	1	16	49	9	3	20	38	4	1	22	39	4	26	48	53
1735	12	10	5	25	8	22	36	30	2	11	10	44	5	4	51	40
1736	0	18	54	2	8	11	52	22	0	20	58	49	5	12	54	27
1737	19	16	26	42	9	0	14	34	11	26	35	55	6	21	37	29
1738	9	1	15	18	8	19	30	26	10	6	24	0	6	29	40	16
1739	27	22	47	58	9	7	52	38	9	12	1	6	8	8	23	18
1740	16	7	36	34	8	27	8	30	7	21	49	11	8	16	26	5
1741	5	16	25	11	8	16	24	22	6	1	37	16	8	24	28	52
1742	24	13	57	52	9	4	46	34	5	7	14	22	10	3	11	54
1743	13	22	46	27	8	24	2	27	3	17	2	27	10	1	14	41
1744	2	7	35	4	8	13	18	20	1	26	50	32	10	19	17	28
1745	21	5	7	44	9	1	40	32	1	2	27	38	11	28	0	30
1746	10	13	56	20	8	20	56	24	11	12	15	43	0	6	3	17
1747	29	11	29	0	9	9	18	36	10	17	52	49	1	14	46	19
1748	17	20	17	36	8	28	34	28	8	27	40	54	1	22	49	5
1749	7	5	6	13	8	17	50	20	7	7	28	59	2	0	51	52
1750	26	2	38	53	9	6	12	32	6	13	6	5	3	9	34	53
1751	15	11	27	29	8	25	28	24	4	22	54	10	3	17	37	40
1752	3	20	16	6	8	14	44	16	3	2	42	15	3	25	40	27
1753	22	17	48	45	9	3	6	28	2	8	19	21	5	4	23	28
1754	12	2	37	22	8	22	22	20	0	18	7	26	5	12	26	15
1755	1	11	25	59	8	11	38	12	10	27	55	31	5	20	29	2
1756	19	8	58	38	9	0	0	24	10	3	32	37	6	29	12	3
1757	8	17	47	15	8	19	16	16	8	13	20	42	7	7	14	50
1758	27	15	19	54	9	7	38	28	7	18	57	48	8	15	57	52
1759	17	0	8	31	8	26	54	20	5	28	45	54	8	24	0	39
1760	5	8	57	8	8	16	10	12	4	8	34	0	9	2	3	26
1761	24	6	29	47	9	4	32	24	3	14	11	6	10	10	46	27
1762	13	15	18	24	8	23	48	16	1	23	59	11	10	18	49	14
1763	3	0	7	1	8	13	4	8	0	3	47	16	10	26	52	1
1764	20	21	39	40	9	1	26	20	11	9	24	21	0	5	35	2
1765	10	6	28	17	8	20	42	13	9	19	12	26	0	13	37	49
1766	29	4	0	56	9	9	4	2[illegible]	8	24	49	32	1	22	20	51

TABLE I. *concluded* O. S.

Years of Chriſt.	New Moon in March.				Sun's Anomaly.				Moon's Anomaly.				Sun's diſt. fr. the Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1767	18	12	49	33	8	28	20	17	7	4	37	37	2	0	23	38
1768	6	21	38	10	8	17	36	9	5	14	25	42	2	8	26	25
1769	25	19	10	49	9	5	58	21	4	20	2	48	3	17	9	27
1770	15	3	59	26	8	25	14	13	2	29	50	53	3	25	12	14
1771	4	12	48	2	8	14	30	5	1	9	38	58	4	3	15	1
1772	22	10	20	43	9	2	52	17	0	15	16	4	5	11	58	3
1773	11	19	9	19	8	22	8	9	10	25	4	9	5	20	0	50
1774	1	3	57	55	8	11	24	1	9	4	52	14	5	28	3	37
1775	20	1	30	35	8	29	46	13	8	10	29	20	7	6	46	38
1776	8	10	19	12	8	19	2	5	6	20	17	25	7	14	49	25
1777	27	7	51	51	9	7	24	17	5	25	54	31	8	23	32	26
1778	16	16	40	28	8	26	40	9	4	5	42	36	9	1	35	13
1779	6	1	29	4	8	15	56	1	2	15	30	41	9	9	38	0
1780	23	23	1	44	9	4	18	13	1	21	7	47	10	18	21	1
1781	13	7	50	21	8	23	34	5	0	0	55	52	10	26	23	48
1782	2	16	38	57	8	12	49	58	10	10	43	57	11	4	26	35
1783	21	14	11	37	9	1	12	10	9	16	21	3	0	13	9	36
1784	9	23	0	13	8	20	28	3	7	26	9	8	0	21	12	23
1785	28	20	32	53	9	8	50	15	7	1	46	14	1	29	55	25
1786	18	5	21	30	8	28	6	7	5	11	34	19	2	7	58	12
1787	7	14	10	6	8	17	21	59	3	21	22	24	2	16	0	59
1788	25	11	42	46	9	5	44	11	2	26	59	30	3	24	44	1
1789	14	20	31	23	8	25	0	3	1	6	47	35	4	2	46	48
1790	4	5	19	59	8	14	15	55	11	16	35	40	4	10	49	35
1791	23	2	52	39	9	2	38	7	10	22	12	46	5	19	32	37
1792	11	11	41	15	8	21	53	59	9	2	0	52	5	27	35	24
1793	30	9	13	55	9	10	16	11	8	7	37	58	7	6	18	26
1794	19	18	2	32	8	29	32	3	6	17	26	4	7	14	21	13
1795	9	2	51	8	8	18	47	55	4	27	14	9	7	22	24	0
1796	27	0	23	48	9	7	10	7	4	2	51	14	9	1	7	1
1797	16	9	12	24	8	26	25	59	2	12	39	19	9	9	9	48
1798	5	18	1	1	8	15	41	51	0	22	27	25	9	17	12	35
1799	24	15	33	41	9	4	4	3	11	28	4	31	10	25	55	37
1800	13	0	22	17	8	23	19	55	10	7	52	36	11	3	58	24

TABLE II. *Mean new moon, &c. in March, new ſtyle, from A. D.* 1752 *to A. D.* 1800.

Years of Chriſt.	New Moon in March.				Sun's Anomaly.				Moon's Anomaly.				Sun's diſt. fr. the Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1752	14	20	16	6	8	14	44	16	3	2	42	15	3	25	40	27
1753	4	5	4	42	8	4	0	8	1	12	30	20	4	3	43	14
1754	23	2	37	22	8	22	22	20	0	18	7	26	5	12	26	15
1755	12	11	25	59	8	11	38	12	10	27	55	31	5	20	29	2
1756	30	8	58	38	9	0	0	24	10	3	32	37	6	29	12	3
1757	19	17	47	15	8	19	16	16	8	13	20	42	7	7	14	50
1758	9	2	35	51	8	8	32	8	6	23	8	47	7	15	17	38
1759	28	0	8	31	8	26	54	20	5	28	45	54	8	24	0	39
1760	16	8	57	8	8	16	10	12	4	8	34	0	9	2	3	26
1761	5	17	45	44	8	5	26	4	2	18	22	5	9	10	6	13
1762	24	15	18	24	8	23	48	16	1	23	59	11	10	18	49	14
1763	14	0	7	1	8	13	4	8	0	3	47	16	10	26	52	1
1764	2	8	55	36	8	2	20	0	10	13	35	21	11	4	54	48
1765	21	6	28	17	8	20	42	13	9	19	12	26	0	13	37	49
1766	10	15	16	53	8	9	58	5	7	29	0	31	0	21	40	37
1767	29	12	49	33	8	28	20	17	7	4	37	37	2	0	23	38
1768	17	21	38	9	8	17	36	9	5	14	25	42	2	8	26	25
1769	7	6	26	46	8	6	52	1	3	24	13	47	2	16	29	13
1770	26	3	59	26	8	25	14	13	2	29	50	53	3	25	12	14
1771	15	12	48	2	8	14	30	5	1	9	38	58	5	3	15	1
1772	3	21	36	39	8	3	45	57	11	17	27	3	4	11	17	48
1773	22	19	9	19	8	22	8	9	10	25	4	9	5	20	0	50
1774	12	3	57	55	8	11	24	1	9	4	52	14	5	28	3	37
1775	1	12	46	31	8	0	39	53	7	14	40	19	6	6	6	24
1776	19	10	19	12	8	19	2	5	6	20	17	25	7	14	49	25
1777	8	19	7	48	8	8	17	57	5	0	5	30	7	22	52	12
1778	27	16	40	28	8	26	40	9	4	5	42	36	9	1	35	13
1779	17	1	29	4	8	15	56	1	2	15	30	41	9	9	38	0
1780	5	10	17	40	8	5	11	53	0	25	18	46	9	17	40	47
1781	24	7	50	21	8	23	34	5	0	0	55	52	10	26	23	48
1782	13	16	38	57	8	12	49	58	10	10	43	57	11	4	26	35
1783	3	1	27	33	8	2	5	50	8	20	32	2	11	12	29	22
1784	20	23	0	13	8	20	28	3	9	26	9	8	0	21	12	23
1785	10	7	48	50	8	9	43	55	6	5	57	13	0	29	15	10
1786	9	5	21	30	8	28	6	7	5	11	34	19	2	7	58	12

TABLE II. *concluded.* *N. S.*

Years of Christ.	New Moon in March.				Sun's Anomaly.				Moon's Anomaly.				Sun's dist. fr. the Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1787	18	14	10	6	8	17	21	59	3	21	22	24	2	16	0	59
1788	6	22	58	42	8	6	37	51	2	1	10	29	2	24	3	46
1789	25	20	31	23	8	25	0	3	1	6	47	35	4	2	46	48
1790	15	5	19	59	8	14	15	55	11	16	35	40	4	10	49	35
1791	4	14	8	35	8	3	31	47	9	26	23	45	4	18	52	22
1792	22	11	41	15	8	21	53	59	9	2	0	52	5	27	35	24
1793	11	20	29	51	8	11	9	51	7	11	48	57	6	5	38	11
1794	30	18	2	32	8	29	32	3	6	17	26	4	7	14	21	13
1795	20	2	51	8	8	18	47	55	4	27	14	9	7	22	24	0
1796	8	11	39	44	8	8	3	47	3	7	2	14	8	0	26	47
1797	27	9	12	24	8	26	25	59	2	12	39	19	9	9	9	48
1798	16	18	1	1	8	15	41	51	0	22	27	25	9	17	12	35
1799	6	2	49	37	8	4	57	43	11	2	15	30	9	25	15	22
1800	25	0	22	17	8	23	19	55	10	7	52	36	11	3	58	24

TABLE III. *Mean Anomalies, and Sun's diſtance from the Node, for 13½ mean lunations.*

N°	Mean Lunations.				Sun's Anomaly.				Moon's Anomaly.				Sun's dist. fr. the Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
1	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
2	59	1	28	6	1	28	12	39	1	21	38	1	2	1	20	28
3	88	14	12	9	2	27	18	58	2	17	27	1	3	2	0	42
4	118	2	56	12	3	26	25	17	3	13	16	2	4	2	40	56
5	147	15	40	15	4	25	31	37	4	9	5	2	5	3	21	10
6	177	4	24	18	5	24	37	56	5	4	54	3	6	4	1	24
7	206	17	8	21	6	23	44	15	6	0	43	3	7	4	41	38
8	236	5	52	24	7	22	50	35	6	26	32	3	8	5	22	52
9	265	18	36	27	8	21	56	54	7	22	21	4	9	6	2	6
10	295	7	20	30	9	21	3	14	8	18	10	4	10	6	42	20
11	324	20	4	33	10	20	9	33	9	13	59	5	11	7	22	34
12	354	8	48	36	11	19	15	52	10	9	48	5	0	8	2	47
13	383	21	32	40	0	18	22	12	11	5	37	6	1	8	43	1
½	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7

TABLE IV. *The Days of the Year, reckoned from the beginning of March.*

Days.	March.	April.	May.	June.	July.	Auguſt.	September.	October.	November.	December.	January.	February.
1	1	32	62	93	123	154	185	215	246	276	307	338
2	2	33	63	94	124	155	186	216	247	277	308	339
3	3	34	64	95	125	156	187	217	248	278	309	340
4	4	35	65	96	126	157	188	218	249	279	310	341
5	5	36	66	97	127	158	189	219	250	280	311	342
6	6	37	67	98	128	159	190	220	251	281	312	343
7	7	38	68	99	129	160	191	221	252	282	313	344
8	8	39	69	100	130	161	192	222	253	283	314	345
9	9	40	70	101	131	162	193	223	254	284	315	346
10	10	41	71	102	132	163	194	224	255	285	316	347
11	11	42	72	103	133	164	195	225	256	286	317	348
12	12	43	73	104	134	165	196	226	257	287	318	349
13	13	44	74	105	135	166	197	227	258	288	319	350
14	14	45	75	106	136	167	198	228	259	289	320	351
15	15	46	76	107	137	168	199	229	260	290	321	352
16	16	47	77	108	138	169	200	230	261	291	322	253
17	17	48	78	109	139	170	201	231	262	292	323	354
18	18	49	79	110	140	171	202	232	263	293	324	355
19	19	50	80	111	141	172	203	233	264	294	325	356
20	20	51	81	112	142	173	204	234	265	295	326	357
21	21	52	82	113	143	174	205	235	266	296	327	358
22	22	53	83	114	144	175	206	236	267	297	328	359
23	23	54	84	115	145	176	207	237	268	298	329	360
24	24	55	85	116	146	177	208	238	269	299	330	361
25	25	56	86	117	147	178	209	239	270	300	331	362
26	26	57	87	118	148	179	210	240	271	301	332	363
27	27	58	88	119	149	180	211	241	272	302	333	364
28	28	59	89	120	150	181	212	242	273	303	334	365
29	29	60	90	121	151	182	213	243	274	304	335	366
30	30	61	91	122	152	183	214	244	275	305	336	
31	31		92		153	184		245		306	337	

TABLE V. *Mean Lunations from* 1 *to* 100000.

Lun.	Days. Decimal Parts.		Days	Hou.	M.	S.	Th.	Fo.
1	29.53059085 1080	=	29	12	44	3	2	58
2	59.061181702160		59	1	28	6	5	57
3	88.591772553240		88	14	12	9	8	55
4	118.122363404320		118	2	56	12	11	53
5	147.652954255401		147	15	40	15	14	52
6	177.183545106481		177	4	24	18	17	50
7	206.714135957561		206	17	8	21	20	48
8	236.244726808641		236	5	52	24	23	47
9	265.775317659722		265	18	36	27	26	45
10	295.3059085 1080		295	7	20	30	29	43
20	590.61181702160		590	14	41	0	59	26
30	885.91772553240		885	22	1	31	29	10
40	1181.22363404320		1181	5	22	1	58	53
50	1476.52954255401		1476	12	42	32	28	36
60	1771.83545106481		1771	20	3	2	58	19
70	2067.14135957561		2069	3	23	33	28	2
80	2362.44726808641		2362	10	44	3	57	46
90	2657.75317659722		2657	18	4	34	27	29
100	2953.0590851080		2953	1	25	4	57	12
200	5906.1181702160		5906	2	50	9	54	24
300	8859.1772553240		8859	4	15	14	51	36
400	11812.2363404320		11812	5	40	19	48	48
500	14765.2954255401		14765	7	5	24	46	0
600	17718.3545106481		17718	8	30	29	43	12
700	20671.4135957561		20671	9	55	34	40	24
800	23624.4726808641		23624	11	20	39	37	36
900	26577.5317659722		26577	12	45	44	34	48
1000	29530.590851080		29530	14	10	49	32	0
2000	59061.181702160		59061	4	21	39	4	0
3000	88591.772553240		88591	18	32	28	36	0
4000	118122.363404320		118122	8	43	18	8	0
5000	147652.954255401		147652	22	54	7	40	0
6000	177183.545106481		177183	13	4	57	12	0
7000	206714.135957561		206714	3	15	46	44	0
8000	236244.726808641		236244	17	26	36	16	0
9000	265775.317659722		265775	7	37	25	48	0
10000	295305.90851080		295305	21	48	15	20	0
20000	590611.81702160		590611	19	36	30	40	0
30000	885917.72553240		885917	17	24	46	0	0
40000	1181223.63404320		1181223	15	13	1	20	0
50000	1476529.54255401		1476529	13	1	16	40	0
60000	1771835.45106481		1771835	10	49	32	0	0
70000	2067141.35957561		2067141	8	37	47	20	0
80000	2362447.26808641		2362447	6	25	2	40	0
90000	2657753.17659722		2657753	4	14	18	0	0
100000	2953059.0851080		2953059	2	2	33	20	0

TABLE VI. *The firſt mean new moon, with the mean anomalies of the ſun and moon, and the ſun's mean diſtance from the aſcending node, next after compleat Julian centuries.*

Lunations.	Julian Cents.	First New Moon.				Sun's Anom.			Moon's Anom.			Sun from Node.		
		D.	H.	M.	S.	s	o	′	s	o	′	s	o	′
1237	100	4	8	10	52	0	3	21	8	15	22	4	19	27
2474	200	8	16	21	44	0	6	42	5	0	44	9	8	55
3711	300	13	0	32	37	0	10	3	1	16	6	1	28	22
4948	400	17	8	43	29	0	13	24	10	1	28	6	17	49
6185	500	21	16	54	21	0	16	46	6	16	50	11	7	16
7422	600	26	1	5	14	0	20	7	3	2	12	3	26	44
8658	700	0	20	32	3	11	24	22	10	21	45	7	15	31
9895	800	5	4	42	55	11	27	43	7	7	7	0	4	58
11132	900	9	12	43	47	0	1	4	3	22	29	4	24	25
12369	1000	13	21	4	40	0	4	25	0	7	51	9	13	53
13606	1100	18	5	15	32	0	7	46	8	23	13	2	3	20
14843	1200	22	13	26	24	0	11	7	5	8	35	6	22	47
16080	1300	26	21	37	16	0	14	28	1	23	57	11	12	15
17316	1400	1	17	4	6	11	18	43	9	13	30	3	1	2
18553	1500	6	1	14	58	11	22	4	5	28	52	7	20	29
19790	1600	10	9	25	50	11	25	25	2	14	14	0	9	56
21027	1700	14	17	36	42	11	28	46	10	29	36	4	29	23
22264	1800	19	1	47	35	0	2	8	7	14	58	9	18	51
23501	1900	23	9	58	27	0	5	29	4	0	20	2	8	18
24738	2000	27	18	9	19	0	8	50	0	15	42	6	27	45
25974	2100	2	13	36	8	11	13	5	8	5	15	10	16	32
27211	2200	6	21	47	1	11	16	26	4	20	37	3	6	0
28448	2300	11	5	57	53	11	19	47	1	5	59	7	25	27
29685	2400	15	14	8	45	11	23	8	9	21	21	0	14	54
30922	2500	19	22	19	38	11	26	29	6	6	43	5	4	22
32159	2600	24	6	30	30	11	29	50	2	22	4	9	23	49
33396	2700	28	14	41	22	0	3	11	11	7	26	2	13	16
34632	2800	3	10	8	11	11	7	26	6	26	59	6	2	3
35869	2900	7	18	19	3	11	10	47	3	12	21	10	21	30
37106	3000	12	2	29	56	11	14	8	11	27	43	3	10	58
38343	3100	16	10	40	48	11	17	30	8	13	5	8	0	25
39580	3200	20	18	51	40	11	20	51	4	28	27	0	19	52

TABLE VI. *concluded.*

Lunations.	Julian Cents.	First New Moon.				Sun's Anom.			Moon's Anom.			Sun from Node.		
		D.	H.	M.	S.	s	o	/	s	o	/	s	o	/
40817	3300	25	3	2	33	11	24	12	1	13	49	5	9	20
42054	3400	29	11	13	25	11	27	33	9	29	11	9	28	47
43290	3500	4	6	40	14	11	1	48	5	18	44	1	17	34
44527	3600	8	14	51	6	11	5	9	2	4	6	6	7	1
45764	3700	12	23	1	59	11	8	30	10	19	28	10	26	29
47001	3800	17	7	12	51	11	11	51	7	4	50	3	15	56
48238	3900	21	15	23	43	11	15	12	3	20	12	8	5	23
49475	4000	25	23	34	35	11	18	33	0	5	34	0	24	50
50711	4100	0	19	1	25	10	22	48	7	25	7	4	13	37
51948	4200	5	3	12	17	10	26	9	4	10	29	9	3	5
53185	4300	9	11	23	9	10	29	31	0	25	51	1	22	32
54422	4400	13	19	34	1	11	2	52	9	11	13	6	11	59
55659	4500	18	3	44	54	11	6	13	5	26	35	11	1	27
56896	4600	22	11	55	46	11	9	34	2	11	57	3	20	54
58133	4700	26	20	6	38	11	12	55	10	27	19	8	10	21
59369	4800	1	15	33	27	10	17	9	6	16	52	11	29	8
60606	4900	5	23	44	20	10	20	31	3	2	14	4	18	36
61843	5000	10	7	55	12	10	23	52	11	17	36	9	8	3
63080	5100	14	16	6	4	10	27	13	8	2	58	1	27	30
64317	5200	19	0	16	56	11	0	34	4	18	20	6	16	57
65554	5300	23	8	27	49	11	3	55	1	3	42	11	6	25
66791	5400	27	16	38	41	11	7	16	9	19	4	2	25	52
68028	5500	2	12	5	30	10	11	31	5	8	37	7	14	39
69265	5600	6	20	16	22	10	14	52	1	23	59	0	4	6
70502	5700	11	4	27	15	10	18	14	10	9	21	4	23	34
71739	5800	15	12	38	7	10	21	35	6	24	43	9	13	1
72976	5900	19	20	48	59	10	24	56	3	10	5	2	2	28
74212	6000	24	4	59	52	10	28	17	11	25	27	6	21	56

If Dr. *Pound*'s mean lunation (which we have kept by in making theſe Tables) be added 74212 times to itſelf, the ſum will amount to 6000 Julian years 24 days 4 hours 59 minutes 51 ſeconds 40 thirds; agreeing with the firſt part of the laſt line of this Table, within half a ſecond.

TABLE VII. *The annual, or firſt equation of the mean to the true Syzygy.*

Argument. **Sun's mean Anomaly.**

Subtract

Degrees	0 Signs			1 Sign			2 Signs			3 Signs			4 Signs			5 Signs			Degrees
	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.	
0	0	0	0	2	3	12	3	35	0	4	10	53	3	39	30	2	7	45	30
1	0	4	18	2	6	55	3	37	10	4	10	57	3	37	19	2	3	55	29
2	0	8	35	2	10	36	3	39	18	4	10	55	3	35	6	2	0	1	28
3	0	12	51	2	14	15	3	41	23	4	10	49	3	32	50	1	56	5	27
4	0	17	8	2	17	52	3	43	26	4	10	39	3	30	30	1	52	6	26
5	0	21	24	2	21	27	3	45	25	4	10	24	3	28	5	1	48	4	25
6	0	25	39	2	25	9	3	47	19	4	10	4	3	25	35	1	41	1	24
7	0	28	55	2	28	29	3	49	7	4	9	39	3	23	0	1	39	56	23
8	0	34	11	2	31	57	3	50	50	4	9	10	3	20	20	1	35	49	22
9	0	38	26	2	35	22	3	52	29	4	8	37	3	17	35	1	31	41	21
10	0	42	39	2	38	44	3	54	4	4	7	59	3	14	49	1	27	31	20
11	0	46	52	2	42	3	3	55	35	4	7	16	3	11	59	1	23	19	19
12	0	51	4	2	45	18	3	57	2	4	6	29	3	9	6	1	19	5	18
13	0	55	17	2	48	30	3	58	27	4	5	37	3	6	10	1	14	49	17
14	0	59	27	2	51	40	3	59	49	4	4	41	3	3	10	1	10	32	16
15	1	3	36	2	54	48	4	1	7	4	3	40	3	0	7	1	6	15	15
16	1	7	45	2	57	53	4	2	18	4	2	35	2	57	0	1	1	56	14
17	1	11	53	3	0	54	4	3	23	4	1	26	2	53	49	0	57	36	13
18	1	16	0	3	3	51	4	4	22	4	0	12	2	50	36	0	53	15	12
19	1	20	6	3	6	45	4	5	18	3	58	52	2	47	18	0	48	52	11
20	1	24	10	3	9	36	4	6	10	3	57	27	2	43	57	0	44	28	10
21	1	28	12	3	12	24	4	6	58	3	55	59	2	40	33	0	40	2	9
22	1	32	12	3	15	9	4	7	41	3	54	26	2	37	6	0	35	36	8
23	1	36	10	3	17	51	4	8	21	3	52	49	2	33	35	0	31	10	7
24	1	40	6	3	20	30	4	8	57	3	51	9	2	30	2	0	26	44	6
25	1	44	1	3	23	5	4	9	29	3	49	26	2	26	26	0	22	17	5
26	1	47	54	3	25	36	4	9	55	3	47	38	2	22	47	0	17	50	4
27	1	51	46	3	28	3	4	10	16	3	45	44	2	19	5	0	13	23	3
28	1	55	37	3	30	26	4	10	33	3	43	45	2	15	20	0	8	56	2
29	1	59	26	3	32	45	4	10	45	3	41	40	2	11	35	0	4	29	1
30	2	3	12	3	35	0	4	10	53	3	39	30	2	7	45	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

Add

TABLE VIII. *Equation of the Moon's mean Anomaly.*

Argument. Sun's mean Anomaly.

Subtract

Degrees	0 Signs			1 Sign			2 Signs			3 Signs			4 Signs			5 Signs			Degrees
	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	
0	0	0	0	0	46	45	1	21	32	1	35	1	1	23	4	0	48	19	30
1	0	1	37	0	48	10	1	22	21	1	35	2	1	22	14	0	46	51	29
2	0	3	13	0	49	34	1	23	10	1	35	1	1	21	24	0	45	23	28
3	0	4	52	0	50	53	1	23	57	1	35	0	1	20	32	0	43	54	27
4	0	6	28	0	52	19	1	24	41	1	34	57	1	19	38	0	42	24	26
5	0	8	6	0	53	40	1	25	24	1	34	50	1	18	42	0	40	53	25
6	0	9	42	0	55	0	1	26	6	1	34	43	1	17	45	0	39	21	24
7	0	11	20	0	56	21	1	26	48	1	34	33	1	16	48	0	37	49	23
8	0	12	56	0	57	38	1	27	28	1	34	22	1	15	47	0	36	15	22
9	0	14	33	0	58	56	1	28	6	1	34	9	1	14	44	0	34	40	21
10	0	16	10	1	0	13	1	28	43	1	33	53	1	13	41	0	33	5	20
11	0	17	47	1	1	29	1	29	17	1	33	37	1	12	37	0	31	31	19
12	0	19	23	1	2	43	1	29	51	1	33	20	1	11	33	0	29	54	18
13	0	20	59	1	3	56	1	30	22	1	33	0	1	10	26	0	28	18	17
14	0	22	35	1	5	8	1	30	50	1	32	38	1	9	17	0	26	40	16
15	0	24	10	1	6	18	1	31	19	1	32	14	1	8	8	0	25	3	15
16	0	25	45	1	7	27	1	31	45	1	31	50	1	6	58	0	23	23	14
17	0	27	19	1	8	36	1	32	12	1	31	23	1	5	46	0	21	45	13
18	0	28	52	1	9	42	1	32	34	1	30	55	1	4	32	0	20	7	12
19	0	30	25	1	10	49	1	32	57	1	30	25	1	3	19	0	18	28	11
20	0	31	57	1	11	54	1	33	17	1	29	54	1	2	1	0	16	48	10
21	0	33	29	1	12	58	1	33	36	1	29	20	1	0	45	0	15	8	9
22	0	35	2	1	14	1	1	33	52	1	28	45	0	59	26	0	13	28	8
23	0	36	32	1	15	1	1	34	6	1	28	9	0	58	7	0	11	48	7
24	0	38	1	1	16	0	1	34	18	1	27	30	0	56	45	0	10	7	6
25	0	39	29	1	16	59	1	34	30	1	26	50	0	55	23	0	8	20	5
26	0	40	59	1	17	57	1	34	40	1	26	7	0	54	1	0	6	44	4
27	0	42	26	1	18	52	1	34	48	1	25	25	0	52	37	0	5	3	3
28	0	43	54	1	19	47	1	34	54	1	24	39	0	51	12	0	3	21	2
29	0	45	19	1	20	40	1	34	58	1	23	52	0	49	45	0	1	40	1
30	0	46	45	1	21	32	1	35	1	1	23	4	0	48	19	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

Add

TABLE IX. *The ſecond equation of the mean to the true Syzygy.*

Argument. Moon's equated Anomaly.

Add

Degrees	0 Signs	1 Sign	2 Signs	3 Signs	4 Signs	5 Signs	Degrees
	H.M. S.	H.M. S.	H.M. S.	H.M. S.	H.M. S.	H.M. S.	
0	0 0 0	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	30
1	0 10 58	5 21 56	8 51 45	9 45 3	8 3 12	4 26 1	29
2	0 21 56	5 30 57	8 56 10	9 45 12	7 57 23	4 17 25	28
3	0 32 54	5 39 51	9 0 25	9 44 11	7 51 33	4 8 47	27
4	0 43 52	5 48 37	9 4 31	9 42 59	7 45 46	4 0 7	26
5	0 54 50	5 57 17	9 8 25	9 41 36	7 39 46	3 51 23	25
6	1 5 48	6 5 51	9 12 9	9 40 3	7 33 36	3 42 32	24
7	1 16 46	6 14 19	9 15 43	9 38 19	7 27 22	3 33 38	23
8	1 27 44	6 22 41	9 19 5	9 36 24	7 21 2	3 24 42	22
9	1 30 40	6 30 57	9 22 14	9 34 18	7 14 30	3 15 44	21
10	1 49 33	6 39 4	9 25 12	9 32 1	7 7 50	3 6 45	20
11	2 0 23	6 47 0	9 27 54	9 29 33	7 1 2	2 57 43	19
12	2 11 10	6 54 46	9 30 32	9 26 54	6 54 8	2 48 39	18
13	2 21 54	7 2 24	9 32 58	9 24 4	6 47 9	2 39 34	17
14	2 32 34	7 9 52	9 35 12	9 21 3	6 40 6	2 30 28	16
15	2 43 9	7 17 9	9 37 14	9 17 51	6 32 56	2 21 19	15
16	2 53 38	7 24 19	9 39 8	9 14 28	6 25 40	2 12 8	14
17	3 4 3	7 31 18	9 40 51	9 10 54	6 18 18	2 2 53	13
18	3 14 24	7 38 9	9 42 21	9 7 9	6 10 49	1 53 36	12
19	3 24 42	7 44 51	9 43 42	9 3 13	6 3 16	1 44 16	11
20	3 34 58	7 51 24	9 44 53	8 59 6	5 55 38	1 34 54	10
21	3 45 11	7 57 45	9 45 52	8 54 50	5 47 54	1 25 31	9
22	3 55 21	8 3 56	9 46 38	8 50 24	5 40 4	1 16 7	8
23	4 5 26	8 9 57	9 47 13	8 45 48	5 32 9	1 6 41	7
24	4 15 26	8 15 46	9 47 36	8 41 2	5 24 9	0 57 13	6
25	4 25 20	8 21 24	9 47 49	8 36 6	5 16 5	0 47 44	5
26	4 35 6	8 26 53	9 47 54	8 31 0	5 7 56	0 38 13	4
27	4 44 42	8 32 11	9 47 46	8 25 44	4 59 42	0 28 41	3
28	4 54 11	8 37 19	9 47 33	8 20 18	4 51 15	0 19 8	2
29	5 3 33	8 42 18	9 47 14	8 14 33	4 43 2	0 9 34	1
30	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	0 0 0	0
Deg.	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	Deg.

Subtract

TABLE X. *The 3d equ. of the mean to the true Syzygy.*

Arg. Sun's Anom.—Moon's Anom.

Degrees	Signs 0 Sub. 6 Add		Signs 1 Sub. 7 Add		Signs 2 Sub. 8 Add		Degrees
	M.	S.	M.	S.	M.	S.	
0	0	0	2	22	4	12	30
1	0	5	2	26	4	15	29
2	0	10	2	30	4	18	28
3	0	15	2	34	4	21	27
4	0	20	2	38	4	24	26
5	0	25	2	42	4	27	25
6	0	30	2	46	4	30	24
7	0	35	2	50	4	32	23
8	0	40	2	54	4	34	22
9	0	45	2	58	4	36	21
10	0	50	3	2	4	38	20
11	0	55	3	6	4	40	19
12	1	0	3	10	4	42	18
13	1	5	3	14	4	44	17
14	1	10	3	18	4	46	16
15	1	15	3	22	4	48	15
16	1	20	3	26	4	50	14
17	1	25	3	30	4	51	13
18	1	30	3	34	4	52	12
19	1	35	3	38	4	53	11
20	1	40	3	42	4	54	10
21	1	45	3	45	4	55	9
22	1	49	3	48	4	56	8
23	1	52	3	51	4	57	7
24	1	56	3	54	4	57	6
25	2	0	3	57	4	57	5
26	2	4	4	0	4	58	4
27	2	9	4	3	4	58	3
28	2	13	4	6	4	58	2
29	2	18	4	9	4	58	1
30	2	22	4	12	4	58	0
Degrees	Signs 5 Sub. 11 Add		Signs 4 Sub. 10 Add		Signs 3 Sub. 9 Add		Degrees

TABLE XI. *The 4th equ. of the mean to the true Syzygy.*

Arg. Sun's dist. from the Node.

Add							
Degrees	0 6 } Sig.		1 7 } Sig.		2 8 } Sig.		Degrees
	M.	S.	M.	S.	M.	S.	
0	0	0	1	22	1	22	30
1	0	4	1	23	1	21	29
2	0	7	1	24	1	20	28
3	0	10	1	25	1	18	27
4	0	13	1	26	1	16	26
5	0	16	1	27	1	14	25
6	0	20	1	28	1	12	24
7	0	23	1	29	1	10	23
8	0	26	1	30	1	8	22
9	0	29	1	31	1	6	21
10	0	32	1	32	1	3	20
11	0	35	1	33	1	0	19
12	0	38	1	33	0	57	18
13	0	41	1	34	0	54	17
14	0	44	1	34	0	54	16
15	0	47	1	34	0	49	15
16	0	50	1	34	0	45	14
17	0	52	1	34	0	41	13
18	0	54	1	34	0	37	12
19	0	57	1	33	0	34	11
20	1	0	1	33	0	31	10
21	1	2	1	32	0	28	9
22	1	5	1	31	0	25	8
23	1	8	1	30	0	22	7
24	1	10	1	29	0	19	6
25	1	12	1	28	0	16	5
26	1	14	1	27	0	13	4
27	1	16	1	26	0	10	3
28	1	18	1	25	0	16	2
29	1	20	1	24	0	3	1
30	1	22	1	22	0	0	0
Deg.	5 11 } Sig.		4 10 } Sig.		3 9 } Sig.		Deg.
Subtract							

TABLE XII. *The ſun's mean longitude, motion, and anomaly: Old Style.*

Years beginning	Sun's mean Longitude. s	°	′	″	Sun's Anomaly. s	°	′
1	9	7	53	10	6	28	48
201	9	9	23	50	6	26	57
301	9	10	9	10	6	26	1
401	9	10	54	30	6	25	5
501	9	11	39	50	6	24	9
1001	9	15	26	30	6	19	32
1101	9	16	11	50	6	18	36
1201	9	16	57	10	6	17	40
1301	9	17	42	30	6	16	44
1401	9	18	27	50	6	15	49
1501	9	19	13	10	6	14	53
1601	9	19	58	30	6	13	57
1701	9	20	43	50	6	13	1
1801	9	21	29	10	6	12	6

Years compleat	Sun's mean Motion. s	°	′	″	Sun's Anomaly. s	°	′
1	11	29	45	40	11	29	45
2	11	29	31	20	11	29	29
3	11	29	17	0	11	29	14
4	0	0	1	49	11	29	58
5	11	29	47	29	11	29	42
6	11	29	33	9	11	29	27
7	11	29	18	49	11	29	11
8	0	0	3	38	11	29	55
9	11	29	49	18	11	29	40
10	11	29	34	58	11	29	24
11	11	29	20	38	11	29	9
12	0	0	5	26	11	29	53
13	11	29	51	7	11	29	37
14	11	29	36	47	11	29	22
15	11	29	22	27	11	29	7
16	0	0	7	15	11	29	50
17	11	29	52	55	11	29	35
18	11	29	38	35	11	29	20
19	11	29	24	16	11	29	4
20	0	0	9	4	11	29	48
40	0	0	18	8	11	29	37
60	0	0	27	12	11	29	26
80	0	0	36	16	11	29	15
100	0	0	45	20	11	29	4
200	0	1	30	40	11	28	8
300	0	2	16	0	11	27	12
400	0	3	1	20	11	26	16
500	0	3	46	40	11	25	21
600	0	4	32	0	11	24	25
700	0	5	17	20	11	23	29
800	0	6	2	40	11	22	33
900	0	6	48	0	11	21	37
1000	0	7	33	20	11	20	41
2000	0	15	6	40	11	11	22
3000	0	22	40	0	11	2	3
4000	1	0	13	20	10	22	44
5000	1	7	46	40	10	13	25
6000	1	15	20	0	10	4	6

Months	Sun's mean Motion. s	°	′	″	Sun's Anomaly. s	°	′
Jan.	0	0	0	0	0	0	0
Feb.	1	0	33	18	1	0	33
Mar.	1	28	9	11	1	28	9
Apr.	2	28	42	30	2	28	42
May	3	28	16	40	3	28	17
June	4	28	49	58	4	28	50
July	5	28	24	8	5	28	24
Aug	6	28	57	26	6	28	57
Sept	7	29	30	44	7	29	30
Oct.	8	29	4	54	8	29	4
Nov	9	29	38	12	9	29	37
Dec.	10	29	12	22	10	29	11

TABLE XII. *concluded.*

Days.	Sun's mean motion and anomaly.				Sun's mean motion and anomaly.				Sun from node.			Sun's mean motion and anomaly.				Sun from node.		
	s	°	′	″	H M S	° ′ ″	′ ″ ‴	″ ‴ ⁗	° ′ ″	′ ″ ‴	″ ‴ ⁗	H M S	° ′ ″	′ ″ ‴	″ ‴ ⁗	° ′ ″	′ ″ ‴	″ ‴ ⁗
1	0	0	59	8														
2	0	1	58	17	1	0	2	28	0	2	36	31	1	16	23	1	20	30
3	0	2	57	25	2	0	4	56	0	5	12	32	1	18	51	1	23	6
4	0	3	56	33	3	0	7	24	0	7	48	33	1	21	19	1	25	42
5	0	4	55	42	4	0	9	51	0	10	23	34	1	23	47	1	28	18
6	0	5	54	50	5	0	12	19	0	12	59	35	1	26	15	1	30	54
7	0	6	53	58	6	0	14	47	0	15	35	36	1	28	42	1	33	29
8	0	7	53	7	7	0	17	15	0	18	11	37	1	31	10	1	36	5
9	0	8	52	15	8	0	19	43	0	20	47	38	1	33	38	1	38	40
10	0	9	51	23	9	0	22	11	0	23	23	39	1	36	6	1	41	16
11	0	10	50	32	10	0	24	38	0	25	58	40	1	38	34	1	43	52
12	0	11	49	40	11	0	27	6	0	28	34	41	1	41	2	1	46	28
13	0	12	48	48	12	0	29	34	0	31	10	42	1	43	30	1	49	4
14	0	13	47	57	13	0	32	2	0	33	45	43	1	45	57	1	51	39
15	0	14	47	5	14	0	34	30	0	36	21	44	1	48	25	1	54	15
16	0	15	46	13	15	0	36	58	0	38	57	45	1	50	53	1	55	51
17	0	16	45	22	16	0	39	26	0	31	33	46	1	53	21	1	59	27
18	0	17	44	30	17	0	41	53	0	44	8	47	1	55	49	2	2	3
19	0	18	43	38	18	0	44	21	0	46	44	48	1	58	17	2	4	39
20	0	19	42	47	19	0	46	49	0	49	20	49	2	0	44	2	7	13
21	0	20	41	55	20	0	49	17	0	51	56	50	2	3	12	2	9	50
22	0	21	41	3	21	0	51	45	0	54	32	51	2	5	40	2	12	25
23	0	22	40	12	22	0	54	13	0	57	8	52	2	8	8	2	15	2
24	0	23	39	20	23	0	56	40	0	59	43	53	2	10	36	2	17	38
25	0	24	38	28	24	0	59	8	1	2	19	54	2	13	4	2	20	14
26	0	25	37	37	25	1	1	36	1	4	55	55	2	15	32	2	22	50
27	0	26	36	45	26	1	4	4	1	7	31	56	2	17	59	2	25	26
28	0	27	35	53	27	1	6	32	1	10	7	57	2	20	27	2	28	2
29	0	28	35	2	28	1	9	0	1	12	43	58	2	22	55	2	30	38
30	0	29	34	10	29	1	11	28	1	15	19	59	2	25	23	2	33	14
31	1	30	33	18	30	1	13	55	1	17	55	60	2	27	51	2	35	50

In leap-years, after February, add one day, and one day's motion.

TABLE XIII. *Equation of the ſun's center, or the difference between his mean and true place.*

Argument. Sun's mean Anomaly.

Subtract

Degrees	0 Signs			1 Sign			2 Signs			3 Signs			4 Signs			5 Signs			Degrees
	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	
0	0	0	0	0	56	47	1	39	6	1	55	37	1	41	12	0	58	53	30
1	0	1	59	0	58	30	1	40	7	1	55	39	1	40	12	0	57	7	29
2	0	3	57	1	0	12	1	41	6	1	55	38	1	39	10	0	55	19	28
3	0	5	56	1	1	53	1	42	3	1	55	36	1	38	6	0	53	30	27
4	0	7	54	1	3	33	1	42	59	1	55	31	1	37	0	0	51	40	26
5	0	9	52	1	5	12	1	43	52	1	55	24	1	35	52	0	49	49	25
6	0	11	50	1	6	50	1	44	44	1	55	15	1	34	43	0	47	57	24
7	0	13	48	1	8	27	1	45	34	1	55	3	1	33	32	0	46	5	23
8	0	15	46	1	10	2	1	46	22	1	54	50	1	32	19	0	44	11	22
9	0	17	43	1	11	36	1	47	8	1	54	35	1	31	4	0	42	16	21
10	0	19	40	1	13	9	1	47	53	1	54	17	1	29	47	0	40	21	20
11	0	21	37	1	14	41	1	48	35	1	53	57	1	28	29	0	38	25	19
12	0	23	33	1	16	11	1	49	15	1	53	36	1	27	9	0	36	28	18
13	0	25	29	1	17	40	1	49	54	1	53	12	1	25	48	0	34	30	17
14	0	27	25	1	19	8	1	50	30	1	52	46	1	24	25	0	32	32	16
15	0	29	20	1	20	34	1	51	5	1	52	18	1	23	0	0	30	33	15
16	0	31	15	1	21	59	1	51	37	1	51	48	1	21	34	0	28	33	14
17	0	33	9	1	23	22	1	52	8	1	51	15	1	20	6	0	26	33	13
18	0	35	2	1	24	44	1	52	36	1	50	41	1	18	36	0	24	33	12
19	0	36	55	1	26	5	1	53	3	1	50	5	1	17	5	0	22	32	11
20	0	38	47	1	27	24	1	53	27	1	49	26	1	15	33	0	20	30	10
21	0	40	39	1	28	41	1	53	50	1	48	46	1	13	59	0	18	28	9
22	0	42	30	1	29	57	1	54	10	1	48	3	1	12	24	0	16	26	8
23	0	44	20	1	31	11	1	54	28	1	47	19	1	10	47	0	14	24	7
24	0	46	9	1	32	25	1	54	44	1	46	32	1	9	9	0	12	21	6
25	0	47	57	1	33	35	1	54	58	1	45	44	1	7	29	0	10	18	5
26	0	49	45	1	34	45	1	55	10	1	44	53	1	5	49	0	8	14	4
27	0	51	32	1	35	53	1	55	20	1	44	1	1	4	7	0	6	11	3
28	0	53	18	1	36	59	1	55	28	1	43	7	1	2	24	0	4	7	2
29	0	55	3	1	38	3	1	55	34	1	42	10	1	0	39	0	2	4	1
30	0	56	47	1	39	6	1	55	37	1	41	12	0	58	53	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

Add

TABLE XIV. *The sun's declination.*

Arg. Sun's true place.

Degrees	Sig. 0 N. 6 S.		Sig. 1 N. 7 S.		Sig. 2 N. 8 S.		Degrees
	°	′	°	′	°	′	
0	0	0	11	30	20	11	30
1	0	24	11	51	20	24	29
2	0	48	12	11	20	36	28
3	1	12	12	32	20	48	27
4	1	36	12	53	20	59	26
5	1	59	13	13	21	10	25
6	2	23	13	33	21	21	24
7	2	47	13	53	21	31	23
8	3	11	14	12	21	41	22
9	3	34	14	31	21	50	21
10	3	58	14	50	21	59	20
11	4	22	15	9	22	8	19
12	4	45	15	28	22	16	18
13	5	9	15	46	22	24	17
14	5	32	16	4	22	31	16
15	5	55	16	22	22	38	15
16	6	18	16	39	22	45	14
17	6	41	16	57	22	51	13
18	7	4	17	14	22	56	12
19	7	27	17	30	23	2	11
20	7	50	17	46	23	6	10
21	8	13	18	2	23	11	9
22	8	35	18	18	23	14	8
23	9	57	18	33	23	18	7
24	9	20	18	48	23	21	6
25	9	42	19	3	23	23	5
26	10	4	19	17	23	25	4
27	10	25	19	31	23	27	3
28	10	47	19	45	23	28	2
29	10	8	19	58	23	29	1
30	10	30	20	11	23	29	0
Deg.	Sig. 11 S. 5 N.		Sig. 10 S. 4 N.		Sig. 9 S. 3 N.		Deg.

TABLE XV. *Equation of the sun's mean distance from the node.*

Arg. Sun's mean Anomaly.

Subtract

Degrees	0 Sig.		1 Sig.		2 Sig.		3 Sig.		4 Sig.		5 Sig.		Degrees
	°	′	°	′	°	′	°	′	°	′	°	′	
0	0	0	1	2	1	47	2	5	1	50	1	4	30
1	0	2	1	4	1	48	2	5	1	48	1	2	29
2	0	4	1	6	1	49	2	5	1	47	1	0	28
3	0	6	1	8	1	50	2	5	1	46	0	58	27
4	0	9	1	10	1	51	2	5	1	45	0	56	26
5	0	11	1	12	1	52	2	5	1	44	0	54	25
6	0	13	1	14	1	53	2	5	1	43	0	52	24
7	0	15	1	16	1	54	2	4	1	41	0	50	23
8	0	17	1	17	1	55	2	4	1	40	0	48	22
9	0	19	1	18	1	56	2	4	1	39	0	46	21
10	0	21	1	19	1	57	2	4	1	37	0	44	20
11	0	23	1	21	1	58	2	3	1	36	0	42	19
12	0	25	1	22	1	58	2	3	1	34	0	40	18
13	0	28	1	24	1	59	2	3	1	33	0	37	17
14	0	30	1	26	2	0	2	2	1	31	0	35	16
15	0	32	1	27	2	0	2	2	1	30	0	33	15
16	0	34	1	28	2	1	2	1	1	28	0	31	14
17	0	36	1	30	2	1	2	1	1	27	0	29	13
18	0	38	1	31	2	2	2	0	1	25	0	27	12
19	0	40	1	34	2	2	2	0	1	24	0	24	11
20	0	42	1	35	2	3	1	59	1	23	0	22	10
21	0	44	1	36	2	3	1	59	1	21	0	20	9
22	0	46	1	37	2	4	1	58	1	19	0	18	8
23	0	48	1	39	2	4	1	57	1	17	0	16	7
24	0	50	1	40	2	4	1	56	1	15	0	13	6
25	0	52	1	41	2	4	1	55	1	13	0	11	5
26	0	54	1	43	2	5	1	54	1	11	0	9	4
27	0	56	1	44	2	5	1	53	1	9	0	7	3
28	0	58	1	45	2	5	1	52	1	8	0	5	2
29	1	0	1	46	2	5	1	51	1	6	0	3	1
30	1	2	1	47	2	5	1	50	1	4	0	0	0
Deg.	11 Sig.		10 Sig.		9 Sig.		8 Sig.		7 Sig.		6 Sig.		Deg.

Add

TABLE XVI.

The moon's latitude in eclipſes.

Arg. Moon's equat. diſtance fr. the node.

0 Signs.
North. Aſc.

6 Signs.
South Deſc.

°	°	′	″	°
0	0	0	0	30
1	0	5	15	29
2	0	10	30	28
3	0	15	45	27
4	0	20	59	26
5	0	26	13	25
6	0	31	26	24
7	0	36	39	23
8	0	41	51	22
9	0	47	2	21
10	0	52	13	20
11	0	57	23	19
12	1	2	31	18
13	1	7	38	17
14	1	12	44	16
15	1	17	49	15
16	1	22	52	14
17	1	27	53	13
18	1	32	52	12

5 Signs.
North Deſc.

11 Signs.
South Aſc.

This Table ſhews the ☽'s latitude no farther than to the utmoſt limits of eclipſes.

TABLE XVII.

The moon's horizontal parallax, with the ſemidiameters and true horary motions of the ſun and moon, to every ſixth degree of their mean anomalies, the quantities for the intermediate degrees being eaſily proportioned by ſight.

Anom. of ſun and moon.		*Moon's horizontal parall.*		*Sun's ſemidiameter.*		*Moon's ſemidiameter.*		*Moon's horary motion.*		*Sun's horary motion.*		*Anom. of ſun and moon.*	
s	°	′	″	′	″	′	″	′	″	′	″	s	°
0	0	54	29	15	50	14	54	30	10	2	23	12	0
	6	54	31	15	50	14	55	30	12	2	23		24
	12	54	34	15	50	14	56	30	15	2	23		18
	18	54	40	15	51	14	57	30	19	2	23		12
	24	54	47	15	51	14	58	30	26	2	23		6
1	0	54	56	15	52	14	59	30	34	2	24	11	0
	6	55	6	15	53	15	1	30	44	2	24		24
	12	55	17	15	54	15	4	30	55	2	24		18
	18	55	29	15	55	15	8	31	9	2	24		12
	24	55	42	15	56	15	12	31	23	2	25		6
2	0	55	56	15	58	15	17	31	40	2	25	10	0
	6	56	12	15	59	15	22	31	56	2	26		24
	12	56	29	16	1	15	26	32	17	2	27		18
	18	56	48	16	2	15	30	32	39	2	27		12
	24	57	8	16	4	15	36	33	11	2	28		6
3	0	57	30	16	6	15	41	33	23	2	28	9	0
	6	57	52	16	8	15	46	33	47	2	29		24
	12	58	12	16	10	15	52	34	11	2	29		18
	18	58	31	16	11	15	58	34	34	2	29		12
	24	58	49	16	13	16	3	34	58	2	30		6
4	0	59	6	16	14	16	9	35	22	2	30	8	0
	6	59	21	16	15	16	14	35	45	2	31		24
	12	59	35	16	17	16	19	36	0	2	31		18
	18	59	48	16	19	16	24	36	20	2	32		12
	24	60	0	16	20	16	28	36	40	2	32		6
5	0	60	11	16	21	16	31	37	0	2	32	7	0
	6	60	21	16	21	16	34	37	10	2	33		24
	12	60	30	16	22	16	37	37	19	2	33		18
	18	60	38	16	22	16	38	37	28	2	33		12
	24	60	45	16	23	16	39	37	36	2	33		6
6	0	60	51	16	23	16	39	37	40	2	33	6	0

To calculate the true time of new or full moon.

PRECEPT I. If the required time be within the limits of the 18th century, write out the mean time of new moon in March, for the propoſed year, from Table I. in the old ſtyle, or from Table II. in the new; together with the mean anomalies of the ſun and moon, and the ſun's mean diſtance from the moon's aſcending node.—If you want the time of full moon in March, add the half lunation at the foot of Table III, with its anomalies, &c. to the former numbers, if the new moon falls before the 15th of March; but if it falls after, ſubtract the half lunation, with the anomalies, &c. belonging to it, from the former numbers, and write down the reſpective ſums or remainders.

II. In theſe additions or ſubtractions, obſerve, that 60 ſeconds make a minute, 60 minutes make a degree, 30 degrees make a ſign, and 12 ſigns make a circle.—When you exceed 12 ſigns in addition, reject 12, and ſet down the remainder.—When the number of ſigns to be ſubtracted is greater than the number you ſubtract from, add 12 ſigns to the leſſer number, and then you will have a remainder to ſet down.—In the Tables, ſigns are marked thus ˢ, degrees thus °, minutes thus ′, and ſeconds thus ″.

III. When the required new or full moon is in any given month after March, write out as many lunations, with their anomalies, and the ſun's diſtance from the node, from Table III, as the given month is after March; ſetting them in order below the numbers taken out for March.

IV. Add all theſe together, and they will give the mean time of the required new or full moon, with the mean anomalies and ſun's diſtance from the aſcending node, which are the arguments for finding the proper equations.

V. With the number of days added together, enter Table IV. under the given month; and againſt that number you have the day of new or full moon in the left-hand column, which ſet before the hours, minutes, and ſeconds, already found.

But (as it will ſometimes happen) if the ſaid number of days falls ſhort of any in the column under the given month, add one lunation and its anomalies, &c. (from Table III.) to the foreſaid ſums, and then you will have a new ſum of days wherewith to enter Table IV. under the given month, where you are ſure to find it the ſecond time, if the firſt falls ſhort.

VI. With the ſigns and degrees of the ſun's anomaly, enter Table VII, and therewith take out the annual or firſt equation for reducing the mean ſyzygy to the true; taking care to make proportions in the Table for the odd minutes and ſeconds of anomaly, as the Table gives the equation only to whole degrees.

Obſerve, in this and every other caſe of finding equations, that if the ſigns are at the head of the Table, their degrees are at the left hand, and are reckoned downward; but if the ſigns are at the foot of the Table, their degrees are at the right hand, and counted upward; the equation being in the body of the Table, under or over the ſigns, and in a collateral line with the degrees.—The titles *add* or *ſubtract* at the head or foot of the Tables where the ſigns are found, ſhew whether the equation is to be added to the mean time of new or full moon, or to be ſubtracted from it. In this Table, the equation is to be ſubtracted, if the ſigns of the ſun's anomaly be found at the head of the Table; but it is to be added, if the ſigns are at the foot.

VII. With the ſigns and degrees of the ſun's mean anomaly, enter Table VIII, and take out the equation of the moon's mean anomaly: ſubtract this equation from her mean anomaly, if the ſigns of the ſun's anomaly be at the head of the Table, but add it, if they be at the foot; the reſult will be the moon's equated anomaly; with which enter Table IX, and take out the ſecond equation for reducing the mean to the true time of new or full moon; adding this equation, if the ſigns of the moon's anomaly be at the head of the Table, but ſubtracting it, if they be at the foot, and the reſult will give you the mean time of the required new or full moon twice equated, which will be ſufficiently near for common almanacks.—But when you want to calculate an eclipſe, the following equations muſt be uſed: thus,

VIII. Subtract the moon's equated anomaly from the ſun's mean anomaly, and with the remainder in ſigns and degrees, enter Table X, and take out the third equation, applying it to the former equated time, as the titles, *add* or *ſubtract*, do direct.

IX. With the ſun's diſtance from the aſcending node, enter Table XI, and take out the equation anſwering to that argument, adding it to, or ſubtracting it from the former equated time, as the titles direct, and the reſult will give the time of

new

new or full moon, agreeing with well-regulated clocks or watches, very near the truth.

The method of calculating the time of any new or full moon without the limits of the 18th century, will be ſhewn further on. And a few Examples compared with the Precepts, will make the whole work plain.

N. B. The Tables begin the day at noon, and reckon forward from thence to the noon following.—Thus, March the 31ſt, at 22 hours 30 minutes 25 ſeconds of tabular time, is April 1ſt, (in common reckoning) at 30 minutes 25 ſeconds after 10 o'clock in the morning.

EXAMPLE I.

Required the true time of new moon in April 1764, new ſtyle?

By the Precepts.	New Moon.	Sun's Anom.	Moon's Ano.	Sun fr. Node.
	D. H. M. S.	s ° ′ ″	s ° ′ ″	s ° ′ ″
March 1764,	2 8 55 36	8 2 20 0	10 13 35 21	11 4 54 48
Add 1 Lunation,	29 12 44 3	0 29 6 19	0 25 49 0	1 0 40 14
Mean new moon,	31 21 39 39	9 1 26 19	11 9 24 21	0 5 35 2
Firſt equation,	+ 4 10 40	11 10 59 18	+ 1 34 57	Sun fr. Node, and Arg. 4th equation.
Time once equ.	32 1 50 19	9 20 27 1	11 10 59 18	
Second equation,	− 3 24 49	Arg. 3d equ.	Arg. 2d equ.	
Time twice equ.	31 22 25 30			
Third equation,	+ 4 37			
Time thrice equ.	31 22 30 37			
Fourth equation,	+ 18			
Tr. new moon,	31 22 30 25			

So the true time is 22h. 30 min. 25 ſec. after the noon of the 31ſt of March; that is, Apr. 1ſt, at 30 min. 25 ſec. after X in the morning.

EXAMPLE II.

Qu. The true time of full moon in May 1762, new ſtyle?

By the Precepts.	New Moon.	Sun's Anom.	Moon's Ano.	Sun fr. Node.
	D. H. M. S.	s ° ′ ″	s ° ′ ″	s ° ′ ″
March 1762,	24 15 18 24	8 23 48 16	1 23 59 11	10 18 49 14
Add 2 lunations,	59 1 28 6	1 28 12 39	1 21 38 1	2 1 20 28
New moon, May,	22 16 46 30	10 22 0 55	3 15 37 12	0 20 9 42
Subt. ½ lunatation,	14 18 22 2	0 14 33 10	6 12 54 30	0 15 20 7
Full moon, May,	7 22 24 28	10 7 27 45	9 2 42 42	0 4 49 35
Firſt equation,	+ 3 16 36	9 3 57 18	+ 1 14 36	Sun fr. Node,
Time once equ.	8 1 41 4	1 3 30 27	9 3 57 18	and Arg. 4th
Second equation,	— 9 47 53	Arg. 3d Equ.	Arg. 2d equ.	equation.
Time twice equ.	7 15 53 11			
Third equation,	— 2 36			
Time thrice equ.	7 15 50 35			
Fourth equation,	+ 15			
Tr. full moon,	7 15 50 50			

Anſ. May 7th at 15 h. 50 m. 50 ſ. paſt noon, *viz.* May 8th at III h. 50 m. 50 ſec. in the morning.

To calculate the time of new or full moon in a given year and month of any particular century, between the Chriſtian æra and the 18th century.

Precept I. Find a year of the ſame number in the 18th century with that of the year in the century propoſed, and take out the mean time of new moon in March, old ſtyle, for that year, with the mean anomalies and ſun's diſtance from the node at that time, as already taught.

II. Take as many compleat centuries from Table VI. as, when ſubtracted from the aboveſaid year in the 18th century, will anſwer to the given year; and take out the firſt mean new moon and its anomalies, &c. belonging to the ſaid centuries, and ſet them below thoſe taken out for March in the 18th century.

III. Subtract the numbers belonging to theſe centuries, from thoſe of the 18th century, and the remainders will be the mean time and anomalies, &c. of new moon in March in the given year of the century propoſed.—Then, work in all reſpects for the true time of new or full moon, as ſhewn in the above Precepts and Examples.

IV. If the days annexed to theſe centuries exceed the number of days ſrom the beginning of March taken out in the 18th century, add a lunation and its anomalies, &c. from Table III. to the time and anomalies of new moon in March, and then proceed in all reſpects as above.—This circumſtance happens in Example V.

EXAMPLE III.

Required the true time of full moon in April, old ſtyle, A. D. 30?

From 1730 ſubtract 1700 (or 17 centuries) and there remains 30.

By the Precepts.	New Moon				Sun's Anom.				Moon's Ano.				Sun fr. Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1730,	7	12	34	16	8	18	4	31	9	0	32	17	1	23	17	16
Add ½ lunation,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full moon,	22	6	56	18	9	2	37	41	3	13	26	47	2	8	37	23
1700 years ſubtr.	14	17	36	42	11	28	46	0	10	29	36	0	4	29	23	0
Full ☽ Mar. *A.D.* 30	7	13	19	36	9	3	51	41	4	13	50	47	9	9	14	23
Add 1 lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
Full moon, April	6	2	3	39	10	2	58	0	5	9	39	47	10	9	54	37
Firſt equation,	+	3	28	4	5	10	58	40		1	18	53	Sun fr. Node,			
Time once equ.	6	5	31	43	4	21	59	20	5	10	58	40	and Arg. 4th			
Second equation,	+	2	57	48	Arg. 3d equ.				Arg. 2d equ.				equation.			
Time twice equ.	6	8	29	31												
Third equation,		—	2	54												
Time thrice equ.	6	8	26	37												
Fourth equation,		—	1	33												
Tr. full moon Apr.	6	8	25	4												

Hence it appears, that the true time of full moon in Apr. *A. D.* 30, O. S. was on the 6th day, at 25 m. 4 ſ. paſt VIII in the evening.

To

To calculate the true time of new or full moon in any given year and month before the Chriſtian æra.

Precept I. Find a year in the 18th century, which being added to the given number of years before Chriſt diminiſhed by one, ſhall make a number of compleat centuries.

II. Find this number of centuries in Table VI, and ſubtract the time and anomalies belonging to it from thoſe of the new moon in March, the above-found year of the 18th century; and the remainders will denote the time and anomalies, &c. of mean new moon in March, the given year before Chriſt. —Then, for the true time thereof in any month of that year, proceed as above taught.

EXAMPLE IV.

Required the true time of new moon in May, old ſtyle, the year before Chriſt 585?

The years 584 added to 1716, make 2300, or 23 centuries.

By the Precepts.	New Moon.				Sun's Anom.				Moon's Ano.				Sun fr. Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1716,	11	17	33	29	8	22	50	39	4	4	14	2	4	27	17	5
2300 years ſubt.	11	5	57	53	11	19	47	0	1	5	59	0	7	25	27	0
Mar. bef. Ch. 585,	0	11	35	36	9	3	3	39	2	28	15	2	9	1	50	5
Add 3 lunations,	88	14	12	9	2	27	18	58	2	17	27	1	3	2	0	42
May bef. Ch. 585,	28	1	47	45	0	0	22	37	5	15	42	3	0	3	50	47
Firſt equation,		—	1	37	5	15	41	17			—	46	Sun fr. Node,			
Time once equ.	28	1	46	8	6	14	41	20	5	15	41	17	and Arg. 4th			
Second equation,	+	2	15	1	Arg. 3d equ.				Arg. 2d equ.				equation.			
Time twice equ.	28	4	1	9												
Third equation,		+	1	9												
Time thrice equ.	28	4	2	18												
Fourth equation,			+	12												
Tr. new moon,	28	4	2	30												

So the true time was May 28th, at 2 minutes 30 ſeconds paſt IV in the afternoon.

Theſe Tables are calculated for the meridian of *London*; but they will ſerve for any other place, by ſubtracting four minutes from the tabular time, for every degree that the meridian of the given place is weſtward of *London*, oradding four minutes for every degree that the meridian of the given place is eaſtward: as in

EXAMPLE V.

Required the true time of full moon at Alexandria *in* Egypt *in September, old ſtyle, the year before Chriſt* 201?

The years 200 added to 1800, make 2000, or 20 centuries.

By the Precepts.	New Moon.	Sun's Anom.	Moon's Ano.	Sun fr. Node.
	D. H. M. S.	s ° ″ ′	s ° ′ ″	s ° ′ ″
March 1800,	13 0 22 17	8 23 19 55	10 7 52 36	11 3 58 24
Add 1 lunation,	29 12 44 3	0 29 6 19	0 25 49 0	1 0 40 14
From the ſum,	42 13 6 20	9 22 26 14	11 3 41 36	0 4 38 38
Subtr. 2000 years,	27 18 9 19	0 8 50 0	0 15 42 0	6 27 45 0
N.M. bef. Chr. 201,	14 18 57 1	9 13 36 14	10 17 59 36	5 6 53 38
Add { 6 lunations,	177 4 24 18	5 24 37 56	5 4 54 3	6 4 1 24
Add { half lun.	14 18 22 2	0 14 33 10	6 12 54 30	0 15 20 7
Full moon Sept.	22 17 43 21	3 22 47 20	10 5 48 9	11 26 15 9
Firſt equation,	— 3 52 6	10 4 19 55	— 1 28 14	Sun fr. Node,
Time once equ.	22 13 51 15	5 18 27 25	10 4 19 55	and Arg. 4th
Second equ.	— 8 25 4	Arg. 3d equ.	Arg. 2d equ.	equation.
Time twice equ.	22 5 26 11			
Third equation,	— 58			
Time thrice equ.	22 5 25 13			
Fourth equation,	— 12			
Time at *London*,	22 5 25 1			
Add for *Alexand.*	2 1 27			
True time there,	22 7 26 28			

Thus it appears, that the true time of full moon at *Alexandria*, in September O. S. the year before Chriſt 201, was the 22d day, at 26m. 28ſ. after VII in the evening.

EXAMPLE VI.

Required the true time of full moon at Babylon *in October, old ſtyle, the year* 4008 *before the firſt year of Chriſt, or* 4007 *before the year of his birth?*

The years 4007 added to 1793, make 5800, or 58 centuries.

By the Precepts.	New Moon.				Sun's Anom.				Moon's Ano.				Sun fr. Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1793,	30	9	13	55	9	10	16	11	8	7	37	58	7	6	18	26
Subtr. 5800 years,	15	12	38	7	10	21	35	0	6	24	43	0	9	13	1	0
N.M. bef. Ch. 4007,	14	20	35	48	10	18	41	11	1	12	54	58	9	23	17	26
Add { 7 lunations,	206	17	8	21	6	23	44	15	6	0	43	3	7	4	41	38
half lun.	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full moon Oct.	22	8	6	11	5	26	58	36	1	26	32	31	5	13	19	11
Firſt equation,		—	13	26	1	26	27	26		—	5	5	Sun fr. Node,			
Time once equ.	22	7	52	45	4	0	31	10	1	26	27	26	and Arg. 4th			
Second equ.	+	8	29	21	Arg. 3d equ.				Arg. 2d equ.				equation.			
Time twice equ.	22	16	22	6												
Third equation,		—	4	10												
Time thrice equ.	22	16	17	56												
Fourth equation,			—	51												
Full moon at *Lond.*	22	16	17	5												
Add for *Babylon*,		2	25	41												
True time there,	22	18	42	46												

So that, on the meridian of *London*, the true time was October 23d, at 17 minutes 5 ſeconds paſt IV in the morning; but at *Babylon*, the true time was Oct. 23d, at 42 min. 46 ſec. paſt VI in the morning.—This is ſuppoſed by ſome to have been the year of the creation.

To calculate the true time of new or full moon in any given year and month after the 18th century.

PRECEPT I. Find a year of the ſame number in the 18th century with that of the year propoſed, and take out the mean time and anomalies, &c. of new moon in March, old ſtyle, for that year, in Table I.

II. Take ſo many centuries from Table V, as when added to the abovementioned year in the 18th century, will anſwer to the given year in which the new or full moon is required: and take out the firſt new moon, with its anomalies for theſe compleat centuries.

III. Add all theſe together, and then work in all reſpects as above ſhewn, only remember to ſubtract a lunation and its anomalies, when the aboveſaid addition carries the new moon beyond the 31ſt of March; as in the following example.

EXAMPLE VII.

Required the true time of new moon in July, old ſtyle, A. D. 2180?

Four centuries (or 400 years) added to A. D. 1780, make 2180.

By the Precepts.	New Moon				Sun's Anom.				Moon's Ano.				Sun fr. Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1780,	23	23	1	44	9	4	18	13	1	21	7	47	10	18	21	1
Add 400 years,	17	8	43	29	0	13	24	0	10	1	28	0	6	17	49	0
From the ſum	41	7	45	13	9	17	42	13	11	22	35	47	5	6	10	1
Subtr. 1 lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
New ☽ Mar. 2180,	11	19	1	10	8	18	35	54	10	26	46	47	4	5	29	47
Add 4 lunations,	118	2	56	12	3	26	25	17	3	13	16	2	4	2	40	56
N. moon, July 2180,	7	21	57	22	0	15	1	11	2	10	2	49	8	8	10	43
Firſt equation,	—	1	3	39	2	9	38	37		—	24	12	Sun fr. Node,			
Time once equ.	7	20	53	43	10	5	22	34	2	9	38	37	and Arg. 4th			
Second equation,	+	9	24	8	Arg. 3d equ.				Arg. 2d equ.				equation.			
Time twice equ.	8	6	17	51												
Third equation,		+	3	56												
Time thrice equ.	8	6	21	47												
Fourth equation,		+	1	8												
True time, July,	8	6	22	55												

True time, July 8, at 22 min. 55 ſec. paſt VI in the evening.

In keeping by the old ſtyle, we are always ſure to be right, by adding or ſubtracting whole hundreds of years to or from any given year in the 18th century. But in the new ſtyle we may be very apt to make miſtakes, on account of the leap-year's not coming in regularly every fourth year:—And therefore, when we go without the limits of the 18th century, we had beſt keep to the old ſtyle; and at the end of the calculation reduce the time to the new. Thus, in the 21ſt century, there will be 14 days difference between the ſtyles; and therefore, the true time of new moon in this laſt Example being reduced to the new ſtyle, will be the 22d of July, at 22 minutes 55 ſeconds paſt VI in the evening.

To calculate the true place of the ſun for any given moment of time.

Precept I. In Table XII, find the next leſſer year in number to that in which the ſun's place is ſought, and write out his mean longitude and anomaly anſwering thereto: to which add his mean motion and anomaly for the compleat reſidue of years, months, days, hours, minutes and ſeconds, down to the given time, and this will be the ſun's mean place and anomaly at that time, in the old ſtyle, provided the ſaid time be in any year after the Chriſtian æra. *See the firſt following Example.*

II. Enter Table XIII with the ſun's anomaly, and making proportions for the odd minutes and ſeconds thereof, take out the equation of the ſun's center; which, being applied to his mean place as the title *add* or *ſubtract* directs, will give his true place or longitude from the vernal equinox, at the time for which it was required.

III. To calculate the ſun's place for any time in a given year before the Chriſtian æra, take out his mean longitude and anomaly for the firſt year thereof, and from theſe numbers, ſubtract the mean motions and anomalies for the compleat hundreds or thouſands next above the given year; and, to the remainders, add thoſe for the reſidue of years, months, &c. and then work in all reſpects as above. *See the ſecond Example following.*

EXAM-

EXAMPLE I.

Required the ſun's true place, March 20th, old ſtyle, 1764, at 22 hours 30 minutes 25 ſeconds paſt noon? —In common reckoning, March 21ſt, at 10 hours 30 minutes 25 ſeconds in the forenoon.

	Sun's Long.				Sun's Anom.			
	s	°	′	″	s	°	′	″
To the radical year after Chriſt 1701	9	20	43	50	6	13	1	0
Add compleat years - - - - - 60	0	0	27	12	11	29	6	0
3	11	29	17	0	11	29	14	0
March	1	28	9	11	1	28	9	0
Biſſextile, Days 20		20	41	55		20	41	55
Hou. 22			54	13			54	13
Min. 30			1	14			1	14
Sec. 25				1				1
Sun's mean place at the given time	0	10	14	36	9	1	27	23
Equation of the ſun's center, add		1	55	36	Mean Anom.			
Sun's true place at the ſame time	0	12	10	12	♈	12	10	12

EXAMPLE II.

Required the ſun's true place, October 23d, old ſtyle, at 16 hours 57 minutes paſt noon, in the 4008th year before the year of Chriſt 1; which was the 4007th before the year of his birth, and the year of the Julian period 706?

By the Precepts.

		Sun's Long.				Sun's Anom.			
		s	°	′	″	s	°	′	″
From the radical numbers aft. Ch. 1		9	7	53	10	6	28	48	0
Subtr. thoſe for 5000 compleat years		1	7	46	40	10	13	25	0
Remains, for a new radix		8	0	6	30	8	15	23	0
To which add to bring it to the given time	compleat years 900	0	6	48	0	11	21	37	0
	80	0	0	36	16	11	29	15	0
	12	0	0	5	26	11	29	53	0
	October	8	29	4	54	8	29	4	0
	Days 23		22	40	12		22	40	12
	Hours 16			39	26			39	26
	Min. 57			2	20			2	20
Sun's mean place at the given time		6	0	3	4	5	28	33	58
Equation of the ſun's center ſubtract				3	4	Sun's Anom.			
Sun's true place at the ſame time		6	0	0	0	♎	0	0	0

So that, in the meridian of London, the ſun was then juſt entering the ſign ♎ *Libra*, and conſequently was upon the point of the autumnal equinox.

If to the above time of the autumnal equinox at London, we add 2 hours 25 minutes 41 ſeconds for the longitude of Babylon, we ſhall have for the time of the ſame equinox at that place, October 23d, at 19 hours 22 minutes 41 ſeconds; which in the common way of reckoning, is October 24th, at 22 minutes 41 ſeconds paſt VII in the morning.

And it appears by Example VI, that in the ſame year, the time of the full moon at Babylon was October 23d, at 42 minutes 46 ſeconds after VI in the morning: ſo that the autumnal equinox was on the day next after the day of full moon.—The dominical letter for that year was G, and conſequently the 24th of October was on a Wedneſday.

To find the ſun's diſtance from the moon's aſcending node, at the time of any given new or full moon; and conſequently, to know whether there is an eclipſe at that time, or not.

The ſun's diſtance from the moon's aſcending node is the argument for finding the moon's fourth equation in the ſyzygies, and therefore it is taken into all the foregoing Examples in finding the times thereof.—Thus, at the time of mean new moon in April 1764, the ſun's mean diſtance from the aſcending node, is $0^s\ 5^\circ\ 35'\ 2''$. *See Example* I. pag. 36.

The deſcending node is oppoſite to the aſcending one, and they are juſt ſix ſigns diſtant from each other.

When the ſun is within 17 degrees of either of the nodes at the time of new moon, he will be eclipſed at that time: and when he is within 12 degrees of either of the nodes at the time of full moon, the moon will be then eclipſed.—Thus we find, that there will be an eclipſe of the ſun at the time of new moon in April, 1764.

But the true time of that new moon comes out by the equations to be 50 minutes 46 ſeconds later than the mean time thereof, by comparing theſe times in the above Example: and therefore, we muſt add the ſun's motion from the node during that interval, to the above mean diſtance $0^{s}\ 5^{\circ}\ 35'\ 2''$, which motion is found in Table XII, for 50 minutes 46 ſeconds, to be $2'\ 12''$. And to this we muſt apply the equation of the ſun's mean diſtance from the node, found by the ſun's anomaly in Table XIII; which anomaly, at the mean time of new moon in Example I, is $9^{s}\ 1^{\circ}\ 26'\ 19''$; and then we ſhall have the ſun's true diſtance from the node, at the true time of new moon, as follows.

	Sun from node			
	s	°	′	″
At mean time of new moon in Apr. 1764	0	5	35	2
Sun's mot. from the node for { 50 min.			2	10
{ 46 ſec.				2
Sun's mean diſt. from node at true new moon	0	5	37	14
Equation of mean diſt. from node, add		2	5	0
Sun's true diſt. from the aſcending node	0	7	42	14

Which, being far within the above limit of 17 degrees, ſhews that the ſun muſt then be eclipſed.

And now we ſhall ſhew how to calculate this, or any other eclipſe, either of the ſun or moon.

To calculate an eclipſe of the ſun.

In order to this, we muſt find the ten following elements, by means of the Tables.

1. The true time of conjunction of the ſun and moon; and at that time, 2. The ſemidiameter of the earth's diſc, as ſeen from the moon, which is equal to the moon's horizontal parallax. 3. The ſun's diſtance from the ſolſtitial colure to which he is then neareſt. 4. The ſun's declination. 5. The angle of the moon's viſible path with the ecliptic. 6. The moon's latitude. 7. The moon's true horary motion from the ſun. 8. The ſun's ſemidiameter. 9. The moon's. 10. The ſemidiameter of the penumbra.

We ſhall now proceed to find theſe elements for the ſun's eclipſe in April 1764.

1. *To find the true time of new moon.* This, by Example I. pag. 36, is found to be on the firſt day of the ſaid month, at 30 minutes 25 ſeconds after X in the morning.

2. *To find the moon's horizontal parallax, or ſemidiameter of the earth's diſc as ſeen from the moon.* Enter Table XVII, with the ſighs and degrees of the moon's anomaly, (making proportions, becauſe the anomaly is in the Table only to every 6th degree) and thereby take out the moon's horizontal parallax; which, for the above time, anſwering to the anomaly $11^s\ 9^\circ\ 24'\ 21''$, is $54'\ 43''$.

3. *To find the ſun's diſtance from the neareſt ſolſtice, viz. the beginning of Cancer, which is* 3^s *or* 90° *from the beginning of Aries.* It appears by the firſt Example on page 44, (where the ſun's place is calculated to the above time of new moon) that the ſun's

longitude from the beginning of Aries is then 0^s 12° 10′ 12″: that is, the ſun's place at that time is ♈ Aries, 12° 10′ 12″.

	s	°	′	″
Therefore from — — — — — —	3	0	0	0
Subtract the ſun's longitude or place — —	0	12	10	12
Rem. the ſun's diſt. from the ſolſtice ♋, =	2	17	49	48

Or 77° 49′ 48″; each ſign containing 30 degrees.

4. *To find the ſun's declination.* Enter Table XIV. with the ſigns and degrees of the ſun's true place, *viz.* 0^s 12°, and making proportions for the 10′ 12″, take out the ſun's declination anſwering to his true place, and it will be found to be 4° 49′ north.

5. *To find the moon's latitude.* This depends on her diſtance from her aſcending node, which is the ſame as the ſun's diſtance from it at the time of new moon; and is thereby found in Table XVI.

But we have already found, that the ſun's equated diſtance from the aſcending node, at the time of new moon in April 1764, is 0^s 7° 42′ 14″. *See pag.* 46.

Therefore, enter Table XVI. with 0 ſigns at the top, and 7 and 8 degrees at the left hand, and take out 36′ 39″, the latitude for 7°, and 41′ 51″, the latitude for 8°; and by making proportions between theſe latitudes for the 42′ 14″, by which the moon's diſtance from the node exceeds 7 degrees; her true latitude will be found to be 40′ 18″ north aſcending.

6. *To find the moon's true horary motion from the ſun.* With the moon's anomaly, *viz.* 11^s 9° 24′ 21″, enter Table XVII, and take out the moon's horary motion; which, by making proportions in that Table, will be found to be 30′ 22″. Then, with the ſun's anomaly, 9^s 1° 26′ 19″, take out his horary motion 2′ 28″ from the ſame Table: and ſubtracting

the latter from the former, there will remain 27′ 54″ for the moon's true horary motion from the ſun.

7. *To find the angle of the moon's viſible path with the ecliptic.* This, in the projection of eclipſes, may be always rated at 5° 35′, without any ſenſible error.

8. 9. *To find the ſemidiameters of the ſun and moon.* Theſe are found in the ſame table, and by the ſame arguments, as their horary motions.—In the preſent caſe, the ſun's anomaly gives his ſemidiameter 16′ 6″, and the moon's anomaly gives her ſemidiameter 14′ 57″.

10. *To find the ſemidiameter of the penumbra.* Add the moon's ſemidiameter to the ſun's, and their ſum will be the ſemidiameter of the penumbra, *viz.* 31′ 3″.

Collect now theſe elements, that they may be the more readily found when they are wanted in the conſtruction of this eclipſe.

	D.	H.	M.	S.
1. True time of new moon in April, 1764	1	10	30	25
		°	′	″
2. Semidiameter of the earth's diſc.		0	54	53
3. Sun's diſtance from the neareſt ſolſtice		77	49	58
4. Sun's declination, north		4	49	0
5. Moon's latitude, north aſcending		0	40	18
6. Moon's horary motion from the ſun		0	27	54
7. Angle of the moon's viſ. path with the ecliptic		5	35	0
8. Sun's ſemidiameter			16	6
9. Moon's ſemidiameter			14	57
10. Semidiameter of the penumbra			31	3

To conſtruct an eclipſe of the ſun geometrically.

1. Make a ſcale of any convenient length, as *AC* (fig. 1.) and divide it into as many equal parts as the earth's ſemi-diſc contains minutes of a de-

gree; which, at the time of the eclipſe in April, 1764, is 54′ 53″. Then, with the whole length of the ſcale as a radius, deſcribe the ſemicircle *AMB* upon the center *C*; which ſemicircle ſhall repreſent the northern half of the earth's enlightened diſc, as ſeen from the ſun.

2. Upon the center *C* raiſe the ſtraight line *CH*, perpendicular to the diameter *ACB*; ſo *ACB* ſhall be a part of the ecliptic, and *CH* its axis.

3. Being provided with a good ſector, open it to the radius *CA* in the line of chords; and taking from thence the chord of 23½ degrees in your compaſſes, ſet it off both ways from *H*, to *g* and to *h*, in the periphery of the ſemi-diſc; and draw the ſtraight line *gVh*, in which the north pole of the diſc will be always found.

4. When the ſun is in Aries, Taurus, Gemini, Cancer, Leo, and Virgo, the north pole of the earth is enlightened by the ſun: but whilſt the ſun is in the other ſix ſigns, the ſouth pole is enlightened, and the north pole is in the dark.

5. And when the ſun is in Capricorn, Aquarius, Piſces, Aries, Taurus, and Gemini, the northern half of the earth's axis *C* XII *P* lies to the right hand of the axis of the ecliptic, as ſeen from the ſun; and to the left hand, whilſt the ſun is in the other ſix ſigns.

6. Open the ſector, till the radius (or diſtance of the two 90's) of the ſines be equal to the length of *Vh*, and take the ſine of the ſun's diſtance from the ſolſtice (77° 49′ 58″) as nearly as you can gueſs, in your compaſſes, from the line of ſines, and ſet off that diſtance from *V* to *P* in the line *gVh*, becauſe the earth's axis lies to the right hand of the axis of

the ecliptic in this caſe, the ſun being in Aries; and draw the ſtraight line *C* XII *P* for the earth's axis, of which *P* is the north pole. If the earth's axis had lain to the left hand from the axis of the ecliptic, the diſtance *V P* would have been ſet off from *V* towards *g*.

7. To draw the parallel of latitude of any given place, as ſuppoſe *London*, or the path of that place on the earth's enlightened diſc as ſeen from the ſun, from ſun-riſe till ſun-ſet, take the following method.

Subtract the latitude of *London*, 51°½ from 90°, and the remainder 38°½ will be the co-latitude, which take in your compaſſes from the line of chords, making *C A* or *C B* the radius, and ſet it from *h* (where the earth's axis meets the periphery of the diſc) to VI and VI, and draw the occult or dotted line VI *K* VI. Then, from the points where this line meets the earth's diſc, ſet off the chord of the ſun's declination 4° 49′ to *D* and *F*, and to *E* and *G*, and connect theſe points by the two occult lines *F* XII *G* and *D L E*.

Biſect *L K* XII in *K*, and through the point *K* draw the black line VI *K* VI. Then making *C B* the radius of a line of ſines on the ſector, take the co-latitude 38° ½ from the ſines in your compaſſes, and ſet it both ways from *K*, to VI and VI.——These hours will be juſt in the edge of the diſk at the equinoxes, but at no other time in the whole year.

With the extent *K* VI taken in your compaſſes, ſet one foot in *K* (in the black line below the occult one) as a center, and with the other foot deſcribe the ſemicircle VI 7 8 9 10 &c. and divide it into 12 equal parts. Then, from theſe points of diviſion, draw the occult lines 7 *p*, 8 *o*, 9 *n*, &c. parallel to the earth's axis *C* XII *P*.

With the ſmall extent *K* XII as a radius, deſcribe the quadrantal arc XII *f*, and divide it into ſix equal parts, as XII *a*, *ab*, *bc*, *cd*, *de*, and *ef*; and through the diviſion-points *a*, *b*, *c*, *d*, *e*, draw the occult lines VII *e* V, VIII *d* IV, IX *c* III, X *b* II, and XI *a* I, all parallel to VI *K* VI, and meeting the former occult lines 7 *p*, 8 *o*, &c. in the points VII VIII IX X XI, V IV III II and I: which points ſhall mark the ſeveral ſituations of London on the earth's diſc, at theſe hours reſpectively, as ſeen from the ſun; and the elliptic curve VI VII VIII, &c. being drawn through theſe points, ſhall repreſent the parallel of latitude, or path of London on the diſc, as ſeen from the ſun, from its riſing to its ſetting.

N. B. If the ſun's declination had been ſouth, the diurnal path of London would have been on the upper ſide of the line VI *K* VI, and would have touched the line *DLE* in *L*.——It is requiſite to divide the horary ſpaces into quarters, (as in the figure) and, if poſſible, into minutes alſo.

8. Make *CB* the radius of a line of chords on the ſector, and taking therefrom the chord of 5° 35′, the angle of the moon's viſible path with the ecliptic, ſet it off from *H* to *M* on the left hand of *C H*, the axis of the ecliptic, becauſe the moon's latitude is north aſcending. Then draw *CM* for the axis of the moon's orbit, and biſect the angle *MCH* by the right line *Cz*.——If the moon's latitude had been north deſcending, the axis of her orbit would have been on the right hand from the axis of the ecliptic.—*N. B.* The axis of the moon's orbit lies the ſame

way when her latitude is ſouth aſcending, as when it is north aſcending; and the ſame way when ſouth deſcending, as when north deſcending.

9. Take the moon's latitude 40′ 18″ from the ſcale *CA* in your compaſſes, and ſet it from *i* to *x* in the biſecting line *Cz*, making *ix* parallel to *Cy*: and through *x*, at right angles to the axis of the moon's orbit *CM*, draw the ſtraight line *NyS* for the path of the penumbra's center over the earth's diſc.——The point *w*, in the axis of the moon's orbit, is that where the penumbra's center approaches neareſt to the center of the earth's diſc, and conſequently is the middle of the general eclipſe: the point *x* is that where the conjunction of the ſun and moon falls, according to equal time by the tables; and the point *y* is the ecliptical conjunction of the ſun and moon.

10. Take the moon's true horary motion from the ſun, 27′ 54″, in your compaſſes, from the ſcale *CA*, (every diviſion of which is a minute of a degree) and with that extent make marks along the path of the penumbra's center, and divide each ſpace, from mark to mark, into 60 equal parts or horary minutes, by dots; and ſet the hours to every 60th minute in ſuch a manner, that the dot ſignifying the inſtant of new moon by the tables, may fall into the point *x*, half way between the axis of the moon's orbit, and the axis of the ecliptic; and then, the reſt of the dots will ſhew the points on the earth's diſc, where the penumbra's center is at the inſtants denoted by them, in its tranſit over the earth.

11. Apply one ſide of a ſquare to the line of the penumbra's path, and move the ſquare backwards and forwards, until the other ſide of it cuts the ſame

hour and minute (as at *m* and *m*) both in the path of London, and in the path of the penumbra's center: and the particular minute or inſtant which the ſquare cuts at the ſame time in both paths, ſhall be the inſtant of the viſible conjunction of the ſun and moon, or middle of the eclipſe, at the place for which the conſtruction is made, namely London, in the preſent example: and this middle time is at 47½ minutes paſt X o'clock in the morning; which is 17 minutes 5 ſeconds later than the tabular time of true conjunction.

12. Take the ſun's ſemidiameter, 16′ 16″, in your compaſſes, from the ſcale *C A*, and ſetting one foot in the path of London at *m*, namely, at 47½ minutes paſt X, with the other foot deſcribe the circle *U Y*, which ſhall repreſent the ſun's diſc as ſeen from London at the middle of the eclipſe.—Then take the moon's ſemidiameter, 14′ 57″, in your compaſſes from the ſame ſcale; and ſetting one foot in the path of the penumbra's center at *m*, in the 47½ minute after X; with the other foot deſcribe the circle *T Y* for the moon's diſc, as ſeen from London, at the middle of the eclipſe, or time of greateſt obſcuration; and the portion of the ſun's diſc which is hid or cut off by the moon's, will ſhew the quantity of the eclipſe at that time; which quantity may be meaſured on a line equal to the ſun's diameter, and divided into twelve equal parts for digits.

13. Laſtly, take the ſemidiameter of the penumbra, 31′ 3″, from the ſcale *C A* in your compaſſes; and ſetting one foot in the line of the penumbra's central path, on the left hand from the axis of the ecliptic, direct the other foot toward the path of

London; and carry that extent backwards and forwards, till both the points of the compaſſes fall into the ſame inſtants in both the paths: and theſe inſtants will denote the time when the eclipſe begins at London.—Then, do the like on the right hand of the axis of the ecliptic; and where the points of the compaſſes fall into the ſame inſtants in both the paths, they will ſhew at what time the eclipſe ends at London.

Theſe trials give 21 minutes after IX in the morning for the beginning of the eclipſe at London at the points *N* and *O*: 47$\frac{1}{2}$ minutes after X, at the points *m* and *m*, for the middle of the eclipſe; and 18$\frac{1}{2}$ minutes after XII, at *R* and *S*, for the time when the eclipſe ends.

In this conſtruction it is ſuppoſed, that the angle under which the moon's diſc is ſeen, during the whole time of this eclipſe, continues invariably the ſame; and that the moon's motion is uniform and rectilineal during that time.—But theſe ſuppoſitions do not exactly agree with the truth; and therefore, ſuppoſing the elements given by the tables to be accurate, yet the times and phaſes of the eclipſe, deduced from its conſtruction, will not anſwer exactly to what paſſeth in the heavens; but may be two or three minutes wrong, tho' done with the greateſt care.—Moreover, the paths of all places of conſiderable latitudes are nearer the center of the earth's diſc, as ſeen from the ſun, than theſe conſtructions make them; becauſe the diſc is projected as if the earth were a perfect ſphere, although it is known to be a ſpheroid. Conſequently, the moon's ſhadow will go farther northward in all places of northern latitude, and farther ſouthward in all places of ſouthern latitude,

tude, than it is ſhewn to do in theſe projections.—And hence we may venture to predict, that this eclipſe will be ſomewhat more central at London than the diagram ſhews it.

The conſtruction of lunar eclipſes.

When the moon is within 12 degrees of either of her nodes, at the time when ſhe is full, ſhe will be eclipſed, otherwiſe not.

We find by Example II, page 37, that at the time of mean full moon in May, 1762, the ſun's diſtance from the aſcending node was only 4° 49′ 35″; and the moon being then oppoſite to the ſun, muſt have been juſt as near her deſcending node, and was therefore eclipſed.

The elements for conſtructing an eclipſe of the moon, are eight in number, as follow:

1. The true time of full moon: and at that time, 2. The moon's horizontal parallax. 3. The ſun's ſemidiameter. 4. The moon's. 5. The ſemidiameter of the earth's ſhadow at the moon. 6. The moon's latitude. 7. The angle of the moon's viſible path with the ecliptic. 8. The moon's true horary motion from the ſun.——Therefore,

1. *To find the true time of full moon.* Work as already taught in the Precepts.—Thus we have the true time of full moon in May 1762, (See Example II. page 37) on the 8th day, at 50 minutes 50 ſeconds paſt III o'clock in the morning.

2. *To find the moon's horizontal parallax.* Enter Table XVII. with the moon's mean anomaly (at the above full) 9ˢ 2° 42′ 42″, and thereby take out her horizontal parallax; which, by making the requiſite proportions, will be found to be 57′ 23″.

3. 4. *To find the ſemidiameters of the ſun and moon.* Enter Table XVII. with their reſpective anomalies, the ſun's being 10ˢ 7° 27′ 45″, (by the above Example) and the moon's 9ˢ 2° 42′ 42″; and thereby take out their reſpective ſemidiameters: the ſun's 15′ 56″, and the moon's 15′ 38″.

5. *To find the ſemidiameter of the earth's ſhadow at the moon.* Add the ſun's horizontal parallax, which is always 10″, to the moon's, which in the preſent caſe is 57′ 23″, the ſum will be 57′ 33″, from which ſubtract the ſun's ſemidiameter 15′ 56″, and there will remain 41′ 37″ for the ſemidiameter of that part of the earth's ſhadow which the moon paſſes through.

6. *To find the moon's latitude.* Find the ſun's true diſtance from the aſcending node (as already taught in page 45) at the true time of full moon; and this diſtance increaſed by ſix ſigns, will be the moon's true diſtance from the ſame node; and conſequently the argument for finding her true latitude, as ſhewn in page 48.

Thus, in Example II, the ſun's mean diſtance from the aſcending node was 0ˢ 4° 49′ 35″, at the time of mean full moon: but it appears by the Example, that the true time thereof was 6 hours 33 minutes 38 ſeconds ſooner than the mean time; and therefore we muſt ſubtract the ſun's motion from the node (found in Table XII. page 29) during this interval, from the above mean diſtance, 0ˢ 4° 49′ 35″, in order to have his mean diſtance from it at the true time of full moon.—Then, to this apply the equation of his mean diſtance from the node, found in Table XV, by his mean anomaly 10ˢ 7° 27′ 45″;

and laſtly add ſix ſigns: ſo ſhall the moon's true diſtance from her aſcending node be found as follows:

	s	°	′	″
Sun from node at mean full moon	0	4	49	35
His mot. from it in 6 hours			15	35
33 minutes			1	26
38 ſeconds				2
Sum, ſubtract from the uppermoſt line			17	3
Rem. his mean diſt. at true full moon	0	4	32	32
Equation of his mean diſtance, add		1	38	0
Sun's true diſtance from the node	0	6	10	32
To which add	6	0	0	0
And the ſum will be	6	6	10	32

Which is the moon's true diſtance from her aſcending node at the true time of her being full; and conſequently the argument for finding her true latitude at that time.—Therefore, with this argument, enter Table XVI, making proportions between the latitudes belonging to the 6th and 7th degree of the argument at the left hand (the ſigns being at the top) for the 10′ 32″, and it will give 32′ 21″ for the moon's true latitude, which appears by the Table to be ſouth deſcending.

7. *To find the moon's true horary motion from the ſun.* With their reſpective anomalies take out their horary motions from Table XVII, as ſhewn in page 48; and the ſun's horary motion ſubtracted from the moon's, leaves remaining the moon's true horary motion from the ſun: in the preſent caſe 30′ 52″.

8. *To find the angle of the moon's viſible path with the ecliptic.* This may be ſtated at 5° 35′, without any error of conſequence in the projection of the eclipſe.

Now collect theſe elements together for uſe.

	D.	H.	M.	S.
1. True time of full moon in May, 1762	8	3	50	50
		°	′	″
2. Moon's horizontal parallax		0	57	23
3. Sun's ſemidiameter		0	15	56
4. Moon's ſemidiameter		0	15	38
5. Semid. of earth's ſhadow at the moon		0	41	37
6. Moon's true latitude, ſouth deſcending		0	32	21
7. Angle of her viſ. path with the ecliptic		5	35	0
8. Her true horary motion from the ſun		0	30	52

Theſe elements being found for the conſtruction of the moon's eclipſe in May, 1762, proceed as follows:

1. Make a ſcale of any convenient length, as *WX* in fig. 2. and divide it into 60 equal parts, each part ſtanding for a minute of a degree.

2. Draw the right line *ACB* (fig. 3.) for part of the ecliptic, and *CD* perpendicular thereto for the ſouthern part of its axis; the moon having ſouth latitude.

3. Add the ſemidiameters of the moon and earth's ſhadow together, which, in this eclipſe, will make 57′ 15″; and take this from the ſcale in your compaſſes, and ſetting one foot in the interſection *C* as a center, with the other foot deſcribe the ſemicircle *ADB*; in one point of which the moon's center will be at the beginning of the eclipſe, and in another at the end thereof.

4. Take the ſemidiameter of the earth's ſhadow, 41′ 37″, in your compaſſes from the ſcale, and ſetting one foot in the center *C*, with the other foot deſcribe the ſemicircle *KLM* for the ſouthern half of the earth's ſhadow, becauſe the moon's latitude is ſouth in this eclipſe.

5. Make *CD* equal to the radius of a line of chords on the ſector, and ſet off the angle of the moon's viſible path with the ecliptic, 5° 35′, from *D* to *E*, and draw the right line *CFE* for the ſouthern half of the axis of the moon's orbit, lying to the right hand from the axis of the ecliptic *CD*, becauſe the moon's latitude is ſouth deſcending.—It would have been the ſame way (on the other ſide of the ecliptic) if her latitude had been north deſcending; but contrary in both caſes, if her latitude had been either north aſcending or ſouth aſcending.

6. Biſect the angle *DCE* by the right line *Cg*; in which line, the true equal time of oppoſition of the ſun and moon falls, as given by the Tables.

7. Take the moon's latitude, 32′ 21″, from the ſcale with your compaſſes, and ſet it from *C* to *G*, in the line *CGg*; and through the point *G*, at right angles to *CFE*, draw the right line *PGN* for the path of the moon's center.—Then, *F* ſhall be the point in the earth's ſhadow, where the moon's center is at the middle of the eclipſe; *G*, the point where her center is at the tabular time of her being full; and *H*, the point where her center is at the inſtant of her ecliptical oppoſition.

8. Take the moon's horary motion from the ſun, 30′ 52″, in your compaſſes from the ſcale; and with that extent make marks along the line of the moon's path *PGN*: then divide each ſpace from mark to mark, into 60 equal parts, or horary minutes, and ſet the hours to the proper dots in ſuch a manner, that the dot ſignifying the inſtant of full moon (*viz.* 50 minutes 50 ſeconds after III in the morning) may

be in the point *G*, where the line of the moon's path cuts the line that biſects the angle *DCE*.

9. Take the moon's ſemidiameter, $15' \; 38''$, in your compaſſes from the ſcale, and with that extent as a radius, upon the points *N*, *F*, and *P*, as centers, deſcribe the circle *Q* for the moon at the beginning of the eclipſe, when ſhe touches the earth's ſhadow at V; the circle *R* for the moon at the middle of the eclipſe; and the circle *S* for the moon at the end of the eclipſe, juſt leaving the earth's ſhadow at *W*.

The point *N* denotes the inſtant when the eclipſe begins, namely, at 15 minutes 10 ſeconds after II in the morning: the point *F* the middle of the eclipſe, at 47 minutes 45 ſeconds paſt III; and the point *P* the end of the eclipſe, at 18 minutes after V. —At the greateſt obſcuration the moon is 10 digits eclipſed.

Concerning an ancient eclipſe of the moon.

It is recorded by *Ptolemy*, from *Hipparchus*, that on the 22d of September, the year 201 before the firſt year of Chriſt, the moon roſe ſo much eclipſed at *Alexandria*, that the eclipſe muſt have begun about half an hour before ſhe roſe.

Mr. *Carey* puts down this eclipſe in his chronology as follows, among ſeveral other ancient ones, recorded by different authors.

Jul. Per.	Ecl. ☽ *Per. Calip.* 2. *An.* 54. *Hor.* 7.	*Nabonaſſar*
4513	*P. M. Alexandr. Dig. ecl.* 10.	547
Sep. 22.	[*Ptolem. l.* 4. *c.* 11.]	*Meſor.* 16.

That is, in the 4513th year of the *Julian* period, which was the 547th year from *Nabonaſſar*, and the

54th year of the ſecond *Calippic* period, on the 16th day of the month *Meſori*, which anſwers to the 22d of September, the moon was 10 digits eclipſed at *Alexandria*, at 7 o'clock in the evening.

Now, as our Saviour was born (according to the *Dionyſian*, or vulgar æra of his birth) in the 4713th year of the *Julian* period, it is plain that the 4513th year of that period was the 200th year before the year of Chriſt's birth; and conſequently 201 years before the year of Chriſt 1.

And, in the year 201, on the 22d of September, it appears by Example V, (page 40) that the moon was full at 26 minutes 28 ſeconds paſt VII in the evening, in the meridian of *Alexandria*.

At that time, the ſun's place was Virgo 26° 14′, according to our Tables; ſo that the ſun was then within 4 degrees of the autumnal equinox: and according to calculation, he muſt have ſet at *Alexandria* about 5 minutes after VI, and about one degree north of the weſt.

The moon being full at that time, would have riſen juſt at ſun-ſet, about one degree ſouth of the eaſt, if ſhe had been in either of her nodes, and her viſible place not depreſſed by parallax.

But her parallactic depreſſion (as appears from her anomaly, *viz.* $10^{s}\ 18^{\circ}$ nearly) muſt have been $55'\ 17''$; which exceeded her whole diameter by $25'\ 9''$; but then, ſhe muſt have been elevated $33'\ 45''$ by refraction; which ſubtracted from her parallax, leaves $21'\ 32''$ for her viſible or apparent depreſſion.

And her true latitude was $30'\frac{1}{2}$ north deſcending, which being contrary to her apparent depreſſion, and greater than the ſame by $8'\ 58''$, her true time of riſing muſt have been juſt about VI o'clock.

Now, as the moon roſe about one degree ſouth of the eaſt at *Alexandria*, where the viſible horizon is land, and not ſea, we can hardly imagine her to have been leſs than 15 or 20 minutes of time above the true horizon before ſhe was viſible.

It appears by fig. 4, which is a delineation of this eclipſe reduced to the time at *Alexandria*, that the eclipſe began at 53 minutes after V in the evening; and conſequently 7 minutes before the moon was in the true horizon: to which, if we add 20 minutes for the interval between her true riſing and her being viſible, we ſhall have 27 minutes for the time that the eclipſe was begun before the moon was viſibly riſen. —The middle of this eclipſe was at 30 minutes paſt VII, when its quantity was almoſt 10 digits, and its ending was at 6 minutes paſt IX in the evening.— So that our Tables come as near to the recorded time of this eclipſe as can be expected, after an elapſe of 1960 years.

FINIS.

ERRATA.

Pag. 10, *l.* 6, *for* nearer *read* farther from. *Same page, l.* 7 *from the bottom, for* VIII *read* VII. *Pag.* 41, *l.* 18 *from the bottom, for* 5 ſeconds *read* 56 ſeconds. *Same page, l.* 6 *from the bottom, for* V *read* VI. *Pag.* 42, *laſt line, for* 21ſt *read* 22d. *Pag.* 44, *l.* 9, *for* 6′ *read* 26′. *Pag.* 46, *l.* 17, *for* XIII *read* XV. *Pag.* 49, *l.* 13 *from the bottom, for* 58″ *read* 48″: *and the ſame in Pag.* 50, *l.* 4 *from the bottom.*

In the Tables. *Pag.* 19, *l.* 7 *from the bottom, for* $8^{s}\ 5^{0}\ 22'\ 52''$ *read* $8^{s}\ 5^{0}\ 21'\ 52''$. *Pag.* 27, *againſt* 16 *in the right hand column, for* 0 M, 54 S, *read* 0 M, 51 S.

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